APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

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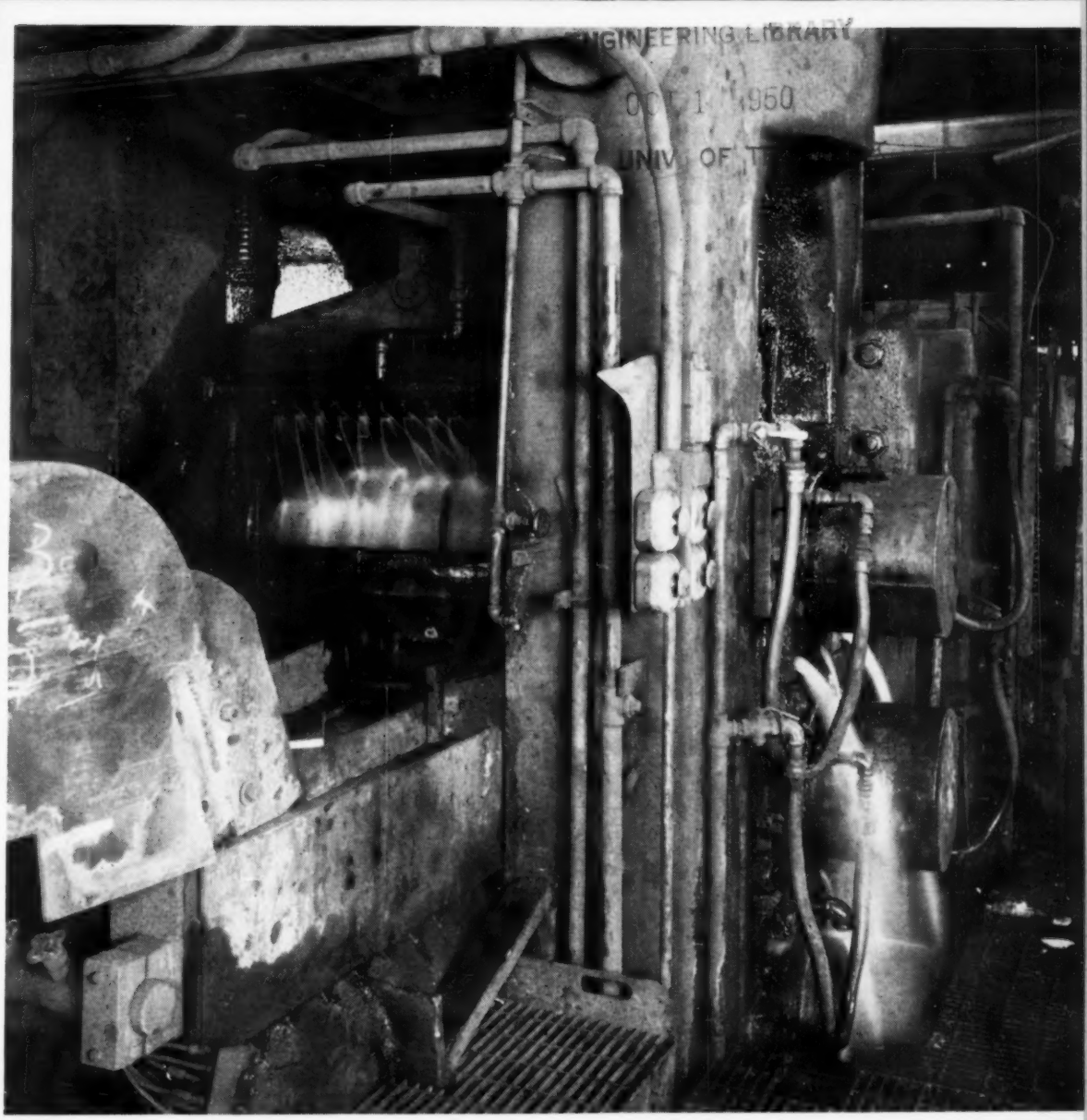

JUNE, 1950

- HYDRAULIC CIRCUITS
- HYDRAULIC CONTROLS
- AIR CIRCUITS
- AIR CONTROLS
- ELECTRICAL AND ELECTRONIC CONTROLS

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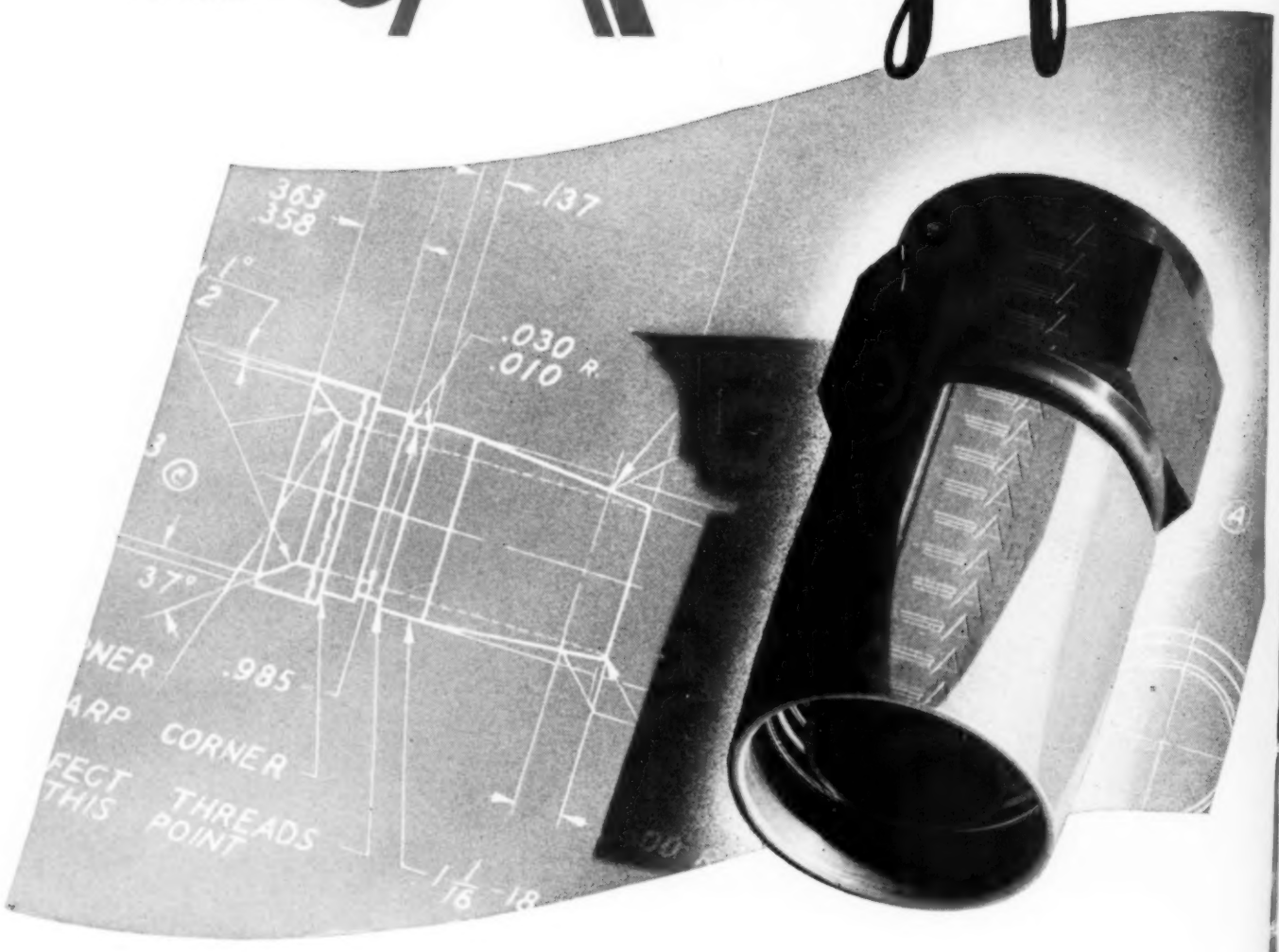

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CUTTING DOLLARS out of a ROLLING SCHEDULE

By ROBERT E. LANCASTER

Chief Engineer
The Weinman Pump & Supply Co.

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This mill is used to reduce a slab 6 inches thick and ten feet long to a strip .67 in thick and 88 ft long in seven passes.

In a three-high mill, Figure 1, the top roll must be held up at all times against the screw down mechanism and the middle roll must be alternately raised and lowered a precise distance with each pass in order to present a varying gap for each pass of the entering metal. This entering gap is critical, since, if it is not correct, the rolls will jump as the metal enters, with a strong possibility of breaking.

While some mills are designed as "jump" mills, i.e., they have no roll balance, they require very heavy housings and rolls. Roll balancing, when done mechanically, required very bulky equipment. Hydraulics offered an efficient and inexpensive method of balancing.

The starting point in the design of the hydraulic circuits was the rolling schedule, shown in Table 1. We were allowed one second between passes to move the middle roll and 30 seconds between the finish of one slab and the start of the next. An elapsed time of four seconds between passes was estimated, but the movement of the tilting tables and the necessity for safety devices gave a net time of one second for roll movement.

Requirements were that the top roll be balanced by a 10 in diameter, single acting ram in the upper mill housing attached through a yoke to the upper roll neck chocks. A minimum force of 40,000 pounds was required or approximately 510 psi. (10 in dia ram = 78.54 sq in x 510 = 40,055) The middle roll was to be balanced by two 5 in, single acting cylinders attached to the housings

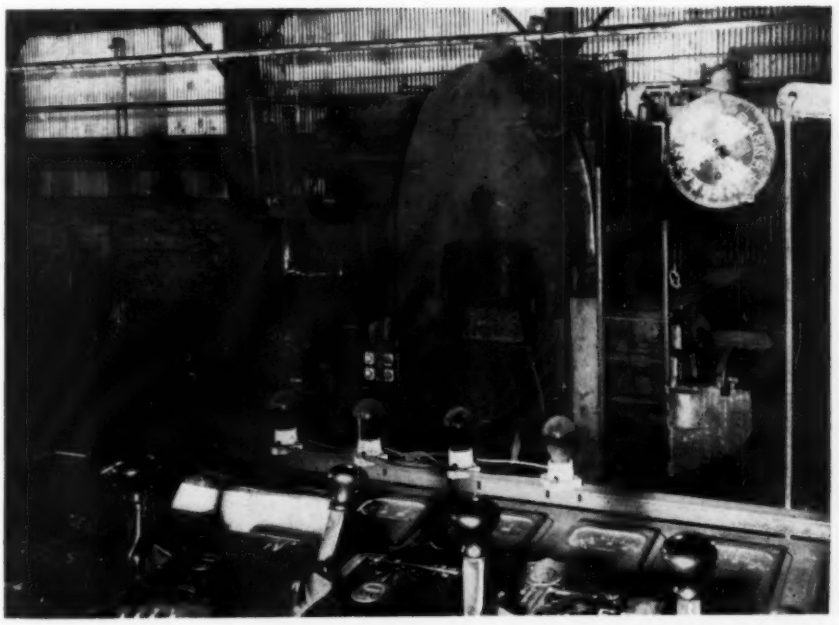

Fig. 1. View of the mill from control pulpit. The indicator dial is geared to the screw downs and indicates the roll opening. One tilting table is shown at left.

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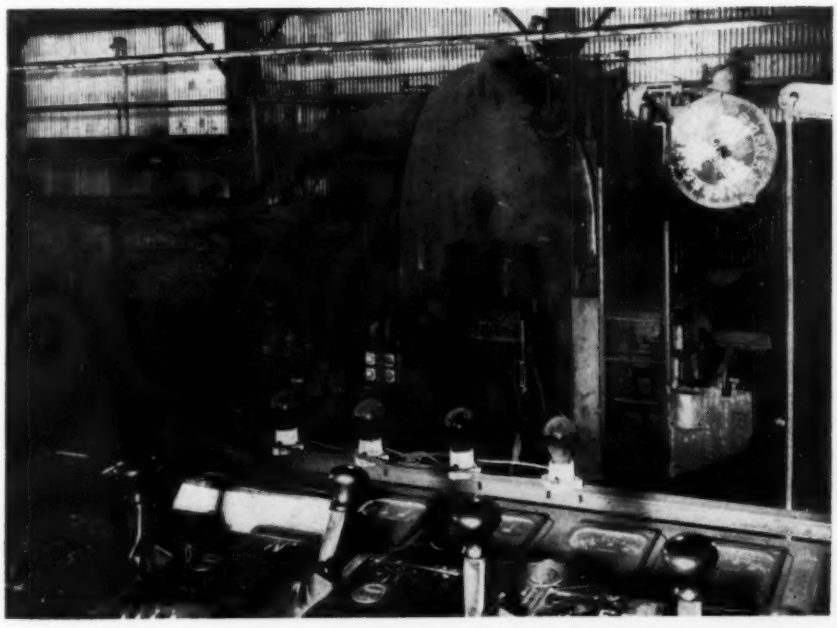


Fig. 1. View of the mill from control pulpit. The indicator dial is geared to the screw downs and indicates the roll opening. One tilting table is shown at left.

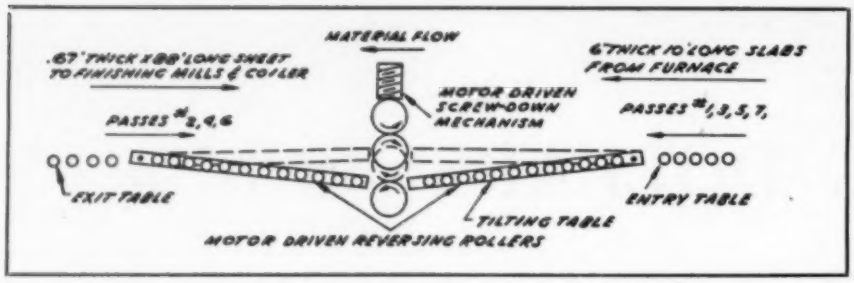

MATERIAL FLOW
.67" THICK X 88" LONG SHEET TO FINISHING MILLS & COILER
6" THICK 10' LONG SLABS FROM FURNACE
MOTOR DRIVEN SCREW-DOWN MECHANISM
PASSES #2, 4, 6
PASSES #1, 3, 5, 7,
EXIT TABLE
ENTRY TABLE
TILTING TABLE
MOTOR DRIVEN REVERSING ROLLERS

Fig. 2. The operation of the three-high mill is shown diagrammatically. The screw down mechanism operates to lower the top roll, which is balanced by a 10 in ram; the middle roll is raised by two 5-in cylinders; operation is actuated by movements of the tilting tables.

Table 1. The rolling schedule, the starting point for building the cycle of the hydraulic system.

Pass No.	Draft Reduction inches	Exit Thickness inches	Exit Length feet	Rolling Time seconds
0	0	6	10	—
1	.9	5.1	11.7	1.17
2	1.3	3.8	15.5	1.55
3	.94	2.86	20.8	2.08
4	1.00	1.86	32	3.2
5	.47	1.39	42.5	4.25
6	.49	.90	65.5	6.55
7	.23	.67	88	8.8
				Total Rolling Time—27.6

and acting through lifting rods on the middle roll chocks. A minimum force of 19,000 pounds was required on the heavier loaded cylinder or approximately 970 psi. (5 in dia cylinder = 19.63 sq in x 970 = 19,041) Both middle roll cylinders must act together so that the roll would not cock. The two cylinders would not be equally loaded.

We set up an analysis, Table 2, to determine the critical oil requirements of the system at any time. As all cylinders were single acting, oil was required from the system only during the "up" strokes.

Oil Power Requirements

By reference to Table 2, it is clear that the system required two peak oil deliveries. One peak was between passes 2 and 3, when .486 gallons in one second would be required to lift the middle roll. This is at the rate of 29.2 gpm. (60 x .486 = 29.2 gpm) Theoretical horsepower for this rate of oil delivery at 1000 psi is 17 hp.

$$\frac{29.2 \times 231 \times 1000}{12 \times 33{,}000} = 17$$

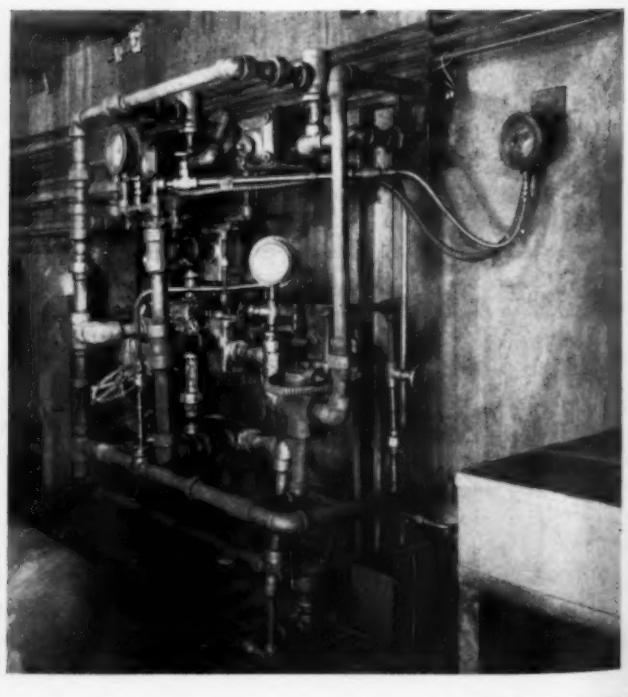
or

$$(.0005833 \times 29.2 \times 1000 = 17)$$

Assuming a system efficiency of 70 percent, actual hp required would be 24.4 bhp.

Fig. 3. Closeup of mill, showing top and middle rolls in the up position. The screw down and top coil yoke are visible. Cooling water is sprayed over the rolls.

Fig. 4. The control assembly panel with valves, gauges and accumulators. The package power unit is in the foreground.



Pass Number	Position of Middle Roll (Down Position = 0)	Movement of Middle Roll + = Up − = Down	Position of Top Roll (Down Position = 0)	Movement of Top Roll + = Up − = Down	Gallons Actual Oil Required from System		Time (Sec)	Total Time (Sec)
					Middle (2)	Top (1)		
Start	+5.1	0	+5.1	0			0	0
No. 1	+5.1	0	+5.1	0			1.17	1.17
Between No. 1 and 2							4	5.17
No. 2	0	−5.1	+3.8	−1.3			1.55	6.72
Between No. 2 and 3							4	10.72
No. 3	+2.86	+2.86	+2.86	− .94	.486		2.08	12.80
Between No. 3 and 4							4	16.80
No. 4	0	−2.86	+1.86	−1.00			3.2	20.00
Between No. 4 and 5							4	24.00
No. 5	+1.39	+1.39	+1.39	− .47	.237		4.25	28.25
Between No. 5 and 6							4	32.25
No. 6	0	−1.39	+ .90	− .49			6.55	38.80
Between No. 6 and 7							4	42.80
No. 7	+ .67	+ .67	+ .67	− .23	.114		8.8	51.60
Between No. 7 and 1		+4.43		+4.43	.755	1.51	30	81.60
					1.592	1.51		
					Total 3.102 gallons			

Table 2. The critical oil requirements of the system at any point in the cycle. The total "work" time per cycle, 15 seconds, was short enough to make the use of an accumulator practical and economical.

The other peak requirement for oil delivery was between the finish of one slab and the start of the next, when both rolls must be lifted simultaneously in 30 seconds. The requirements were .755 gallons for the middle roll cylinders and 1.51 gallons for the top ram or a total of 2.265 gallons, a rate of 4.53 gpm.

The total oil required for the entire rolling cycle of 81.6 seconds was 3.102 gallons (Table 2), a rate of 2.3 gpm.

Summarizing the oil delivery requirement, we have: (1) an instantanous requirement of 29.2 gpm; (2) a 30 second requirement of 4.53 gpm; and (3) an average requirement over the entire cycle of 2.3 gpm.

To take care of the heaviest load —the instantaneous requirement—a 30 gpm pump at 1000 psi with 20 or 25 bhp, was one solution. However, to effect economy, we decided to incorporate an accumulator in the circuit (Figures 4 and 5) and store up the capacity of the pump during the no-work periods, which totaled 66.6 seconds out of the total cycle of 81.6 seconds, for release to the system during the peak load periods.

We selected a piston type pump with a capacity of 5.5 gpm at 1250 psi, requiring 5 bhp. The pump was arranged with the solenoid operated unloading valve and a pressure switch set to cut the pump in at 1100 psi and to unload at 1250 psi. By using a bladder type hydropneumatic accumulator, we had a margin of 100 psi between the minimum pump pressure and our 1000 psi system requirement. A five gallon shell capacity accumulator with a 950 psi precharge pressure gave adequate storage at this 100 psi differential to make the maximum stroke on the middle roll cylinders at any time. Actually two 5-gallon accumulators were used, one acting as a spare, simplifying service or maintenance and adding an extra safeguard against downtime.

Hydraulic Circuit

Three important operating conditions had to be considered in the op-

(Continued on page 35)

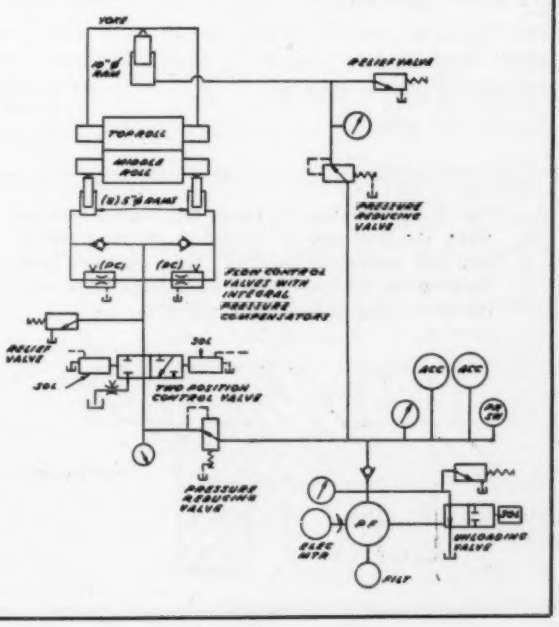


Fig. 5. Schematic of hydraulic circuit. Note essential simplicity of equipment to perform required functions.

Factors Influencing "O" Ring Operation

Some design considerations and a list of points to check in the selection of "O" ring compounds.

By TOMMY J. McCUISTION
and
ROBERT E. ALLEN

THERE ARE MANY FACTORS WHICH, when properly applied in correct combinations, tend to give satisfactory operation and long life to "O" ring seals. This article will discuss a number of these factors or points so that the designing or operating engineer may understand and avoid common causes of trouble.

The small area of "O" ring contact in relation to other types of seals and gaskets is a very definite advantage. This permits designs to be compact, efficient and economical. Furthermore, the human element generally present in other types of packing installations is eliminated.

One of the prime advantages of "O" rings is that it seals tighter and tighter as pressure is applied. When used as gaskets for flanges and flanged fittings, bolts need be only finger tight and there are no unequal stresses that may crack the flanges or stretch the bolting.

In using "O" rings, one of the most important points to remember is that the dimetral squeeze or interference that is applied to the "O" ring by the fit of the metal parts must be maintained throughout the effective life of the unit. In order to do this the design of the metal parts must be correct and the right "O" ring compound must be chosen.

Design Considerations

Synthetic rubber should be thought of as a very viscous fluid with high surface tension. When used as packings, the harder, or more viscous it is, the higher the pressure it takes to extrude or make the synthetic rubber flow through a given size opening. Conversely, the smaller the opening the higher the pressure a given compound will withstand. Several different compounds of the same hardness may vary in their resistance to extrusion due to a difference in modulus.

Fig. 1. This design is poor for high pressure since the end cap is distorted as pressure is applied, reducing the "O" ring squeeze and tending to extrude the compound into the clearance gap away from the pressure.

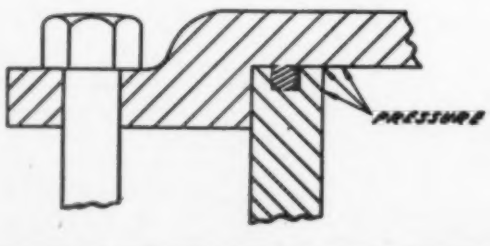
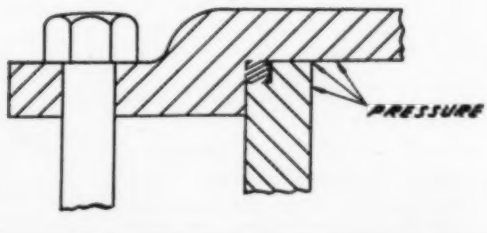


Fig. 2. In this modification of the design of Figure 1, pressure tends to help the sealing action of the "O" ring; the clearance gap is always less than the initial clearance gap as the pressure is increased.



Experience has indicated dimensions, tolerances and clearances for various types of installations. For example, the effect of breathing of the metal parts under high pressure must receive careful consideration. Figure 1 shows a high pressure design that has given trouble. As the pressure is applied the end cap is distorted, reducing the "O" ring squeeze and at the same time tending to extrude the "O" ring compound into the clearance gap away from the pressure. Then when the pressure is released, the metal parts return quickly to their original position before the synthetic rubber seal has a chance to return to its original shape. This action takes a bite out of the "O" ring. Continuing, successive applications and releases of pressure take additional bits from the "O" ring until its loses its initial squeeze and will no longer seal. By modifying the design as shown in Figure 2, the fluid pressure tends to help the sealing action of the "O" ring by insuring that the clearance gap is always less than the initial clearance gap as the pressure is increased.

Excessive stretching of the "O" ring is another cause of failure. This becomes more and more critical as temperatures are increased. An excessively stretched "O" ring will show signs of stress-cracking which may not be noticed until the seal has been in service for rather long periods of time or at excessively high temperatures.

Stress-cracking is caused by the natural resilience of the synthetic rubber trying to return to its original shape. When the cross section of the "O" ring is distorted or flattened by stretching, the "O" ring has a tendency to take an excessive compression set. Therefore it is recommended that "O" rings not be stretched more than a minimum.

"Pumping" leakage, as it is sometimes called, may be eliminated by reducing the groove length or changing the compound*. No trouble will be encountered if the designer will make the OD of the groove in a flange joint type of installation slightly smaller than the OD of the ring that is to be used. This is shown in Figure 3.

Figure 4 shows a design that has been rather widely used where it is quite likely that "pumping" leakage may be encountered. Note that the ID of the "O" ring is tight on the ID of the groove. As the pressure is applied, the "O" ring is stretched and rolled to the OD of the groove at the start of each pressure cycle and returns to the OD of the groove as the pressure is released. The rolling of the ring, particularly in the case of very smooth grooves, will cause leakage to occur.

"O" Ring Compound Selection

The average design engineer cannot be expected to be a synthetic rubber expert. Scant published information is available to him. The

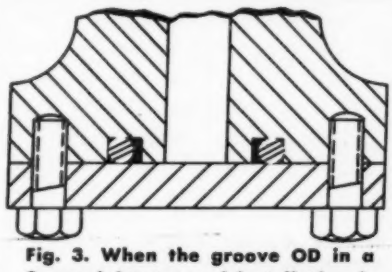


Fig. 3. When the groove OD in a flange joint type of installation is slightly smaller than the OD of the ring, as shown, no "pumping" leakage trouble is encountered.

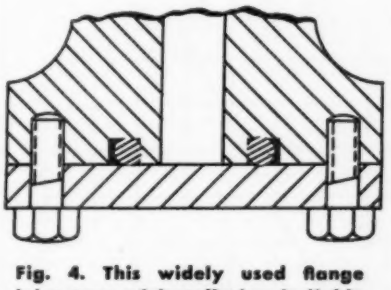


Fig. 4. This widely used flange joint type of installation is liable to develop "pumping" leakage when, as shown, the ID of the "O" ring is tight on the ID of the groove. The ring is stretched and rolled to the OD of the groove as pressure is applied and returns to the ID of the groove as pressure is released.

ASTM-SAE rubber specifications are good as far as they go, but in many cases, they are not restrictive enough to insure that the purchaser will obtain good "O" ring compounds. While compound information and manufacturing techniques are the stock-in-trade of the "O" ring manufacturers and their development work for individual customers is confidential, their experience in furnishing proper compounds for specific jobs and to meet exact problems is available to the design and operating engineer.

In general the following are the points to check:

1. *Fluid Effects.* The effect of fluid on the compound should be carefully considered. Low aniline point oils may swell the compound 10 to 15 percent. This is not cause for alarm. The high aniline point oils may shrink a compound, particularly after the fluid has been dried out of the compound. If such shrinkage is not too severe, this is not too serious. Also, the other physical properties should be carefully checked for compound deterioration after exposure to the fluid.

While a given compound may have a volumetric shrinkage of approximately 6 percent in a particular fluid, it is evident, by reference to the conversion graph, Figure 5, that this is only a 2 percent linear shrinkage, representing, for example, only .002 in in the cross sectional squeeze for a ring with an initial cross section of .103 in.

2. *Compression Set.* Briefly, the compression set of a compound is the loss or lack of recovery after being subjected to a specified squeeze. The ASTM compression set test is an accelerated aging test of a synthetic rubber compound and gives a good indication of its ability to return to its original shape after it has been in service. "O" ring manufacturers refer to compression set as a percentage of the original thickness. A slight reduction of the "O" ring cross section, due to shrinkage after exposure to the fluid, may cause much less difficulty than compounds with poor compression set properties.

3. *Vibration.* Hydraulic units that are subject to vibration or sharp side loads sometimes give trouble, due to hysterisis or a relatively slow rate of recovery of the rubber effect after compression. Excessive hysterisis may be caused by the following manufacturing and compounding faults:

(a) Poor Milling Technique

"O" ring compounds require that the milling time be adequate to insure proper dispersion of all ingredients used in the compound. The tempera-

* "How to Eliminate the Problem of "O" Ring Leakage," APPLIED HYDRAULICS, February, 1949.

ture must be carefully controlled to avoid over-heating, scorching or setting up of the compound.

(b) Improper Curing
Every synthetic rubber compound has an optimum curing time to give it the best properties. This curing or vulcanizing must be carefully controlled by using exact amounts of curing agents, as well as the proper time and temperature.

(c) Improper Compounding
Conventional synthetic rubber compounds very seldom make good "O" rings. Proper formulation, requiring experience and competence, is an art in itself.

(d) Heat Resistance
There is a great difference in the ability of various compounds to resist heat, cracking and vibration, even though the same basic type of synthetic rubber is used. If the temperature conditions are high or the operation involves rapid flexing of the "O" ring, proper compounding is absolutely necessary. In addition, where vibration is encountered, it is sometimes helpful to use "O" rings with larger cross sections. This is particularly true of the very small sizes.

(e) Stress Aging
There is very little information available on this characteristic. The primary function of the well known Army-Navy crush test (Specification AN-P-79) is to show whether a compound will fail by stress aging. In actual reciprocating service, compounds which do not pass this test are liable to develop what is known as "spiral failure".

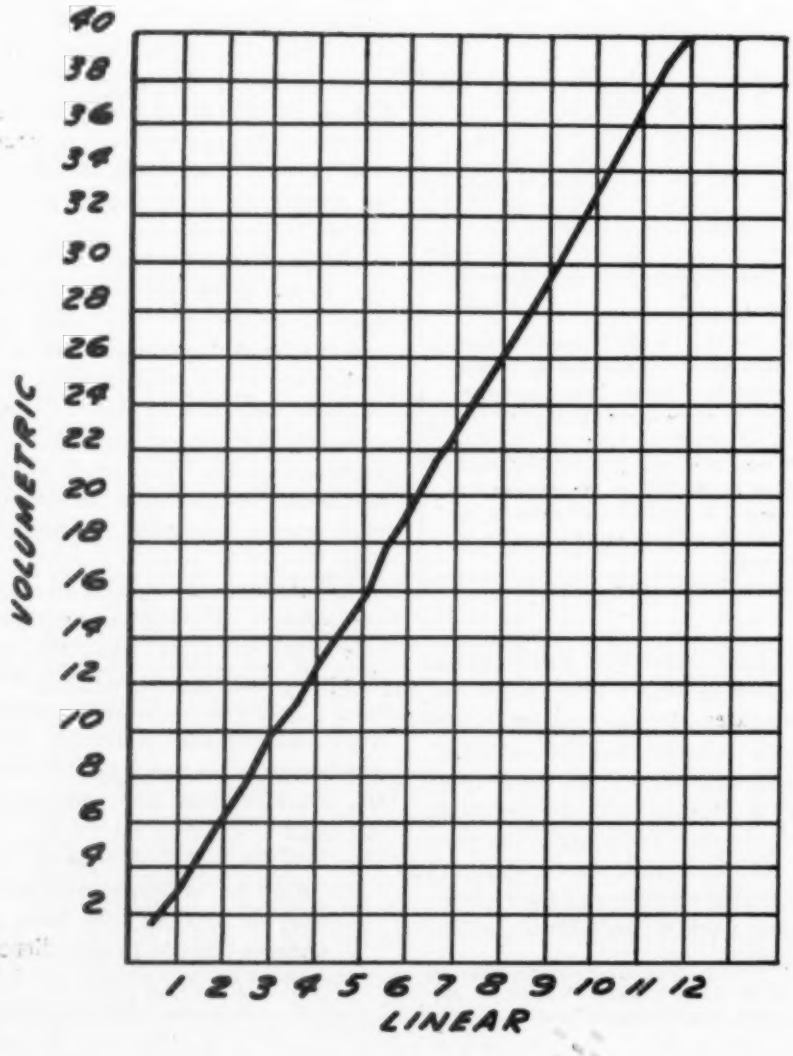
(f) Corrosion
Some rubber compounding ingredients will cause, or induce, corrosion. Some of the plasticizers used to improve processing of the compound may also cause trouble. Powdered graphite, sometimes used to reduce friction, will cause electrolytic pitting of chrome iron types of stainless steels.

In some cases the manufacturer, after having tested and approved a hydraulic unit with a recommended "O" ring compound, accepts another vendor that is not a specialist in "O" ring compounding and manufacture. This often proves expensive due to field trouble and service work. It is often just as important to select a competent supplier as it is to select a proper compound. In addition to improper formulation and processing of the compound; the lack of good housekeeping and quality control, e.g., the inclusion of dirt or other foreign matter in the "O" ring may result in service failures. In making precision "O" rings great care, cleanliness, quality control and good housekeeping are a must.

Some of the best "O" ring compounds are extremely difficult to process. Often they require special mixing, preparation, precise curing cycles and very close control throughout. It is possible to improve the expected service life by ten times or more by using compounds particularly developed for a given fluid and/or for the reciprocating mechanism with which it is used.

There is no synthetic rubber compound that will "cover the waterfront" of all of the many and varied services encountered. "O" rings have their definite advantages and limitations; when, for a given design, the proper compound is selected and used, "O" rings can eliminate many sealing problems, help provide optimum operating conditions and give long service life.

Fig. 5. The curve on this conversion graph indicates the relationship of volumetric shrinkage to linear shrinkage.



Bound copies of the proceedings of the 5th Annual Meeting of the National Conference on Industrial Hydraulics, held last October, is now being distributed. They may be obtained by writing Mr. Frank W. Edwards, Conference Secretary, Illinois Institute of Technology, Chicago 16, Ill.

The Eighth of a Series of Articles on Air Circuit Design

AIR CIRCUIT FOR SLOTTING MACHINE

By W. J. SCHUPNER
Design Engineer
Chicago, Illinois

THE DESIGN AND MANUFACTURE OF small machine parts frequently calls for a slotting operation. Conventional milling machines serve this purpose but on quantity runs the production rate is usually slow with resulting high cost per piece. A specially built slotting machine employing the use of air power to actuate the feed table and indexing mechanism has been developed by Hanna Engineering Works, of Chicago, for use in their shop, and has proved very successful. It will handle up to 500 units per hour and is so designed that the use of adapters permits instant changeover from one size part to another.

Four cylinders are used to complete the work cycle, three of which are air operated, while the fourth functions as a dashpot to cushion the table movement and control the feed rate. The power unit incorporates a gearshift drive connected by "V" belts to the motor and provides flexibility in speed selection for different classes of work. A small flywheel on the output shaft furnishes the energy necessary in maintaining speed during the cutting operation. The machine movements are fully automatic and continuous. Parts to be slotted are manually inserted and removed by the operator.

The control circuit diagram is shown schematically in Figure 1, with the various components oriented in correct position for the beginning of the work stroke. The machine may be stopped or reversed at any point in the cycle by pressing

(Continued on page 28)

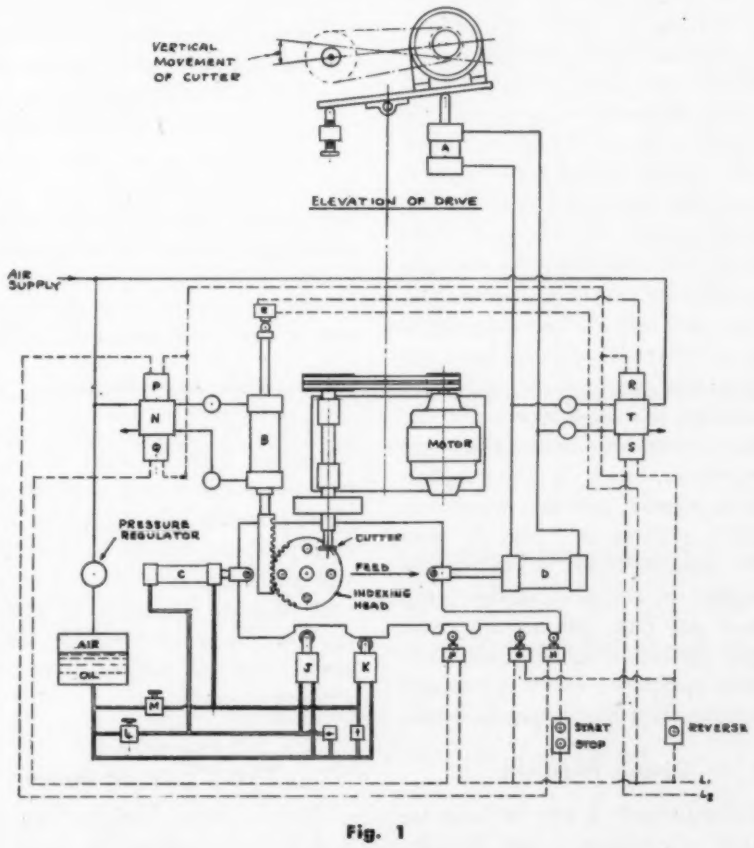


Fig. 1

PRESSURE ACTUATED SWITCHES

By GEORGE A. STARBIRD

PART II

Flow

NORMALLY, ONE DOES NOT THINK of flow or movement of liquids or gases in connection with pressure sensing devices. It is obvious, however, that flow must be present before pressure changes can occur. If fluids did not flow from one location to another when pressure changes occur, little or no need would exist for pressure gauges, switches and other similar devices. Liquids or gases traveling through tubes and pipes at various velocities and volumes produce varying friction losses. All fluids (and gases are fluids) have mass and therefore have inertia and follow one or more of Newton's three laws of motion. This inertia loss will become very important when the velocity in a pipe or tube is great. Care must be used in locating the pressure actuated switch in the part of the system where it will not be subjected to surge or reflected pressures in excess of those that are to be sensed.

Flow is, unfortunately, only one result of pressure difference. Energy is expended, work is done, turbulence is present, inertia is overcome. In fact, activity in hydraulic flow under high pressures is comparable to traffic on the busiest thoroughfares of any city. The big difference is that confusion in hydraulic flow is only apparent; every movement is strictly according to physical law.

Gauge Pressure

Gauge pressure is any pressure indicated by a selected gauge. Usually, these devices are of a commercial nature and the accuracy is determined by the manufacturer's design. Gauges usually measure a difference in vacuum between ambient or barometric and some unknown value.

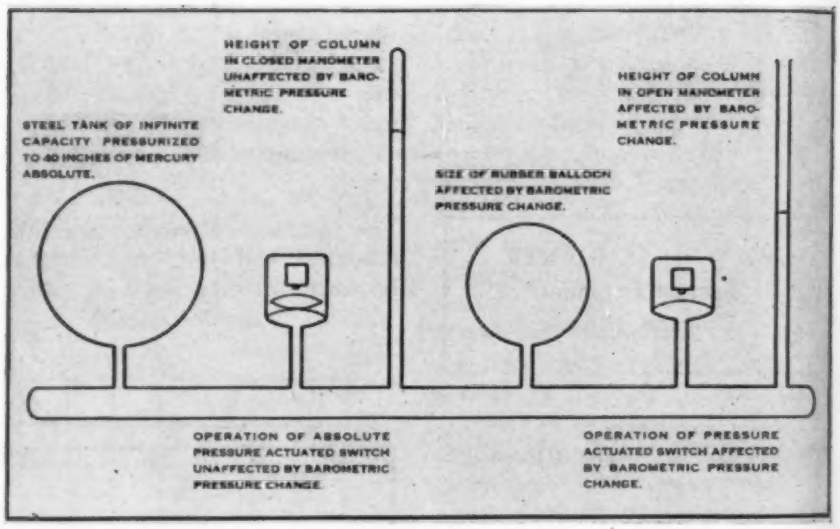

HEIGHT OF COLUMN IN CLOSED MANOMETER UNAFFECTED BY BAROMETRIC PRESSURE CHANGE.
STEEL TANK OF INFINITE CAPACITY PRESSURIZED TO 40 INCHES OF MERCURY ABSOLUTE.
HEIGHT OF COLUMN IN OPEN MANOMETER AFFECTED BY BAROMETRIC PRESSURE CHANGE.
SIZE OF RUBBER BALLOON AFFECTED BY BAROMETRIC PRESSURE CHANGE.
OPERATION OF ABSOLUTE PRESSURE ACTUATED SWITCH UNAFFECTED BY BAROMETRIC PRESSURE CHANGE.
OPERATION OF PRESSURE ACTUATED SWITCH AFFECTED BY BAROMETRIC PRESSURE CHANGE.

Fig. 3. Open and closed end manometers; open manometer pressure readings may be in either atmospheric or absolute units, closed manometer readings will be in reference to atmospheric pressure.

Reference Pressure

This term is usually applied to the controlled fluid pressure when the pressure is other than ambient (ambient pressure may be called reference pressure, but for simplification will not be included here). The reference pressure is usually the lower of the two pressures being sensed and always the one subject to the least amount of variation.

Impedance
The Cause of Surge

This is normally an electrical term and it is not ordinarily used with hydraulic circuits. One of the reasons this term has not been used may be attributed to the fact that until the last few years the term "hydraulic" was generally associated with low pressures that pertained to domestic water systems and similar uses. With these, low pressures, velocity, and inertia played only a small part in the problems involved.

Modern hydraulic systems utilizing high pressures that produce high velocities produce violent disturbances. A solenoid valve, for example, that suddenly interrupts the free flow produces this kind of a condition. Velocity, inertia, and friction loss, consequently, play a very important part in systems employing solid fluids.

The effect of the velocity and the inertia of the fluid to be started and stopped approximately equals mv^2. Mv^2 is the mass or weight multiplied

by the square of the velocity. Therefore, the inertia loss in a pipe or tube when the velocity is great will become very important.

To this loss must be added the friction loss which is caused by the rough pipe or tubing, bends, valves, restrictors and other similar obstructions. Friction losses also are in the magnitude of the square of the velocity. Therefore, when friction loss is added to the first loss (mv^2), the pressure drop can be very large during the time between the removing of a restriction, such as a valve, and full uniform flow.

Surge is a transient rise of hydraulic pressure in the circuit. If no change or rate of flow occurred in a system there would be little need for pressure sensing devices. Where changes in pressure are gradual the effects of surges or pulsations are of little importance. It is only where these rapid changes are of large magnitude that troubles may arise.

Snubbing

Because of their compressibility, snubbing of gases is seldom necessary. At times it is desirable or necessary that pressure actuated switches be protected hydraulically from the effects of surges. This is most readily accomplished by the use of "snubbers," which serve to increase the friction head loss, or impedance in the line leading to the pressure actuated switch. The most effective and practical method of protecting the instrument is by means of a restrictor, which can be any suitable type of diameter-reducing element inserted in the line through which the liquid must flow. Another method, in systems having working pressures of 500 psi or more and which are subject to unusual surge conditions, is by means of a needle valve and a short length of synthetic tubing connected in series in the line leading to the instrument. Occasionally, porous materials are used for snubbing; these have the disadvantage of clogging and are therefore not recommended.

Hysteresis (Lag)

Hysteresis may be defined as "a lagging or retardation of the effect, when the forces acting on the body are changed as if from viscosity or internal friction." This phenomenon is important in pressure actuated switch applications where accuracy and sensitivity are important. When the pressure tending to open a Bourdon tube is released, the Bourdon tube will not immediately return to its original position due to hysteresis. Several hours may be required before the hysteresis effect is overcome unless an external force returns the Bourdon tube beyond its original position sufficiently to overcome the effect. The hysteresis effect is generally less than a pound or two in most cases and is important only where accuracy of less than one inch of mercury is required.

Methods Of Measuring Pressure Or Vacuum

Gauge Pressure (Reference Pressure is ambient)

Bourdon tube type pressure gauges are the most common instruments for measuring pressures when extreme accuracy is not required. Because the ambient pressure on the outside of the Bourdon tube affects the results, barometric pressure is used as a reference point and the results will vary according to the barometric change. Pressures so determined are usually written, "psig", the abbreviation for Pounds Per Square Inch Gauge.

Open End Manometer (Reference pressure is usually ambient)

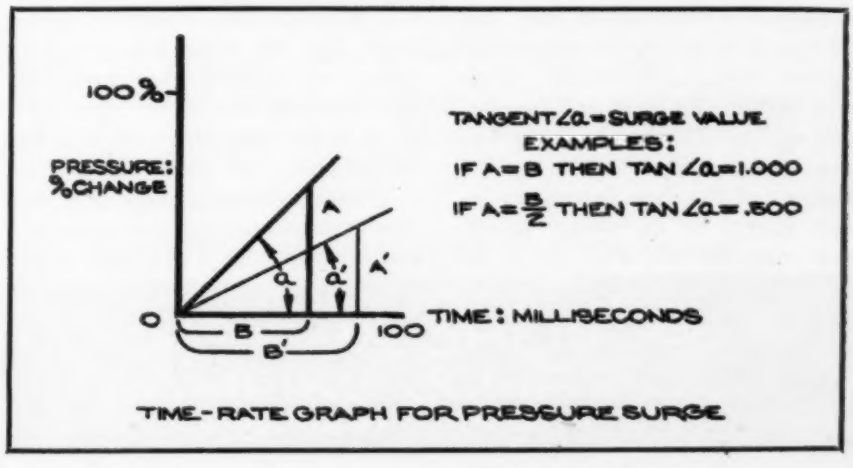
This method of measurement utilized a "U" shaped glass tube. This tube is usually partially filled with water or mercury and pressure applied to one end. As the pressure is increased the liquid is forced down in one tube and rises in the other. The weight of this column exerts a pressure equal to that applied for measurement. If the atmospheric pressure can exert a force on the liquid being measured, the results will be in absolute units. For example, if an open tank of water were connected to a mercury manometer, the atmospheric pressure would be the same on the water surface as it is on the surface of the mercury. In this case, the readings would be independent of barometric pressures, and the values would be absolute.

If the pressure being measured is isolated from the atmospheric pressure, the values will be in absolute units but will be low because of the weight of the atmosphere on the column in the open end of the manometer. The values will be in absolute units but will be reduced by an amount equal to the weight of the atmosphere on the liquid in the open end of the manometer. The local barometric pressure would need to be added to correct the results. An example of this would be measuring pressure in a sealed flask or cylinder.

Closed Manometer (Reference pressure is zero absolute)

Because atmospheric pressure differs at various elevations, an absolute system of pressure measurement is required. This system uses zero pressure, or what we commonly think of as perfect vacuum as the reference or starting point. The manometer for this type of measurement is a glass tube filled with mercury and hermetically sealed at the

Fig. 4. Time-rate graph for pressure surge. The percentage of pressure change is plotted against the log of the surge time in milliseconds.



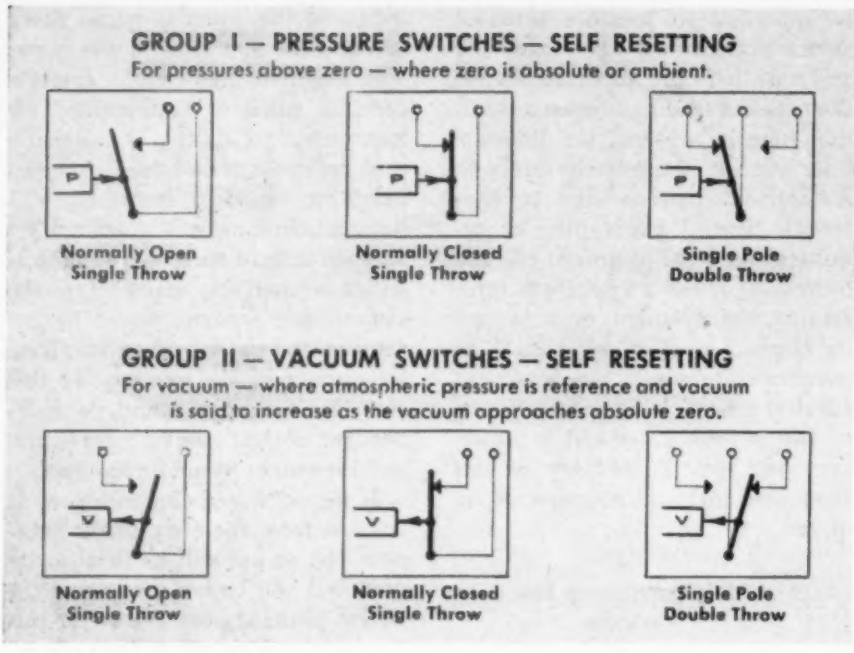


Fig. 5. Symbols recommended for circuit of pressure and vacuum switches.

upper end. The lower end of this tube is immersed in a well or sump. The column of mercury drops until its height above the sump equals the force exerted by the atmosphere. This force at sea level is usually approximately 30 inches; and at 18,000 feet, about half this value.

When pressure or vacuum is applied to the well or sump on this type of manometer, the column of mercury will rise or fall equal to a value that will be in absolute units. At no place can atmospheric pressure come in direct contact with the mercury to permit barometric pressure to change the results. This type of measuring apparatus is necessary where the results of pressure measurements must be more accurate than usually permitted by fluctuations in barometric changes.

Measurement Of Surge

Surge is a phenomenon that is so relative that accurate measurement is often difficult. Obviously, surges may vary in amplitude and speed of propagation. The speed of propagation is determined largely by the pressure of the fluid and the resistance offered by the piping, valves, and other devices. If surge is described as a sudden increase in pressure, then some value must be employed for the word "sudden". Some system of measuring surges must be used, therefore, if the language of engineers is to be complete.

One method of measuring surge is the system similar to the H and D curve of the photographer. The percentage of pressure change can then be plotted against the log of the time required for the surge (Figure 4). The time should be plotted in fractions of seconds. Surge values can then be based on the tangent of resulting angle.

Diagrams And Symbols

An artist's conception of a hydraulic system, consisting of check valves, pumps, cylinders, etc., would be entirely unsatisfactory for two reasons. First, because the time involved would be excessive; second, because many hydraulic components can be identical in external appearance, but entirely different in operation. As a result, the language of engineers, to be universally understood by engineers, should consist of universally recognized symbols. The use of symbols in some phases of hydraulics has simplified and clarified blue prints specifications so that they are understood by all engineers and construction men.

However, little has been done toward establishing a language of symbols for the phase of hydraulics dealing with pressure actuated switches. One reason may be that these devices are more complex than generally believed. For example, pressure and vacuum switches are designed to provide control or warning for extremely sensitive pressure, or for pressure measured in thousands of pounds. Where it is desired to put the operational requirement of a pressure actuated switch on paper, a schematic method is recommended. It will be noted that no mention is made (Figure 5) of the electrical requirements; only that the switch is required, in this case, to be actuated at a given pressure and reactuated at another pressure. As pressure is directional, i.e., increases or decreases, an arrow is used in the suggested symbols to indicate this direction.

Schematic Symbols

For circuit detailing and specification purposes, the functional schematic symbols applicable to pressure and vacuum actuated switches shown in Figure 5 are recommended as indicating the required circuit operating conditions. Due to certain design requirements of some pressure actuated switches, the circuit schematics will be transposed with respect to the wiring of the switch proper under certain conditions. As an example, pressure actuated switches may be required to *open* or *close* an electrical circuit on *increasing pressure;* the switch capsule is in the *actuated* position until the diaphragm or Bourdon tube releases the switch operating mechanism, thereby closing the electrical circuit. The markings on the switch capsule under this condition will be *reversed* relative to the external wiring connections. The markings will also be transposed with respect to the associated functional switch symbol. This example holds true where circuit requirements require a switch to *open* or *close* on *decreasing pressure.*

In conclusion, industry needs a common nomenclature and a set of symbols that will be universally understood for pressure actuated switches and their applications. The desirability of taking constructive action toward a solution of the problem is apparent. By attempting to focus the attention of engineers and management on this problem, the author hopes that additional thinking will be stimulated and accelerate a solution of this and other problems pertaining to the nature and applications of these instrument mechanisms.

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WRITE FOR DETAILED DESCRIPTIVE LITERATURE

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New PRODUCTS

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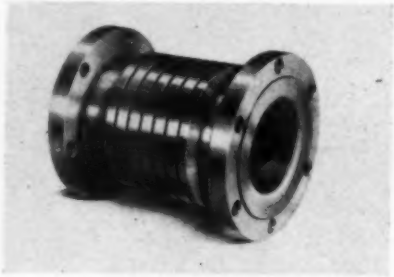
Liquid Pressure Regulator

The new Series 2H Norgren liquid pressure regulator, designed for handling water, oil and non-corrosive liquids up to 200 F where close regulation of secondary pressure is desired, is announced by C. A. Norgren Co. Design features include baffle plate and siphon tube action, which permits greater flow with less pressure drop. The diaphragm is of water- and oil-resistant synthetic rubber reinforced with nylon cloth. Dashpot chamber parts are designed and built for greater resistance to wear and corrosion. Series 2H regulators are compact and easy to install, have in-line pipe connections so that the regulator can be dismantled without removal from the line. *1.*

High Pressure Expansion Joints

Chicago Metal Hose Corporation announces a new line of expansion joints for the 1000 psi working pressure range. Designed for absorbing radial and offset motion as well as axial motion, the "Flexoniflex" units have been used successfully in confidential projects for several years. The joints consist of corrugated, bellows-type sections of stainless steel or other alloys formed within



integral control rings and end sections, rings are not bolted in place. The joints are made with single or multiple plies and lined or unlined; sizes begin at 5/8 in ID. *2.*

Self Contained Linear Actuator

A completely self-contained, heavy-duty hydraulic linear actuator, the Hydractor, designed for applications requiring a constant and positive straight line push or pull, is announced by Benjamin Lassman & Son. The Hydractor

consists of an electric motor, pump, fluid reservoir, double acting cylinder and solenoid-operated control valve all mounted to form a compact packaged hydraulic power unit. A completely sealed system using a synthetic, non-sludging, fire-resistant hydraulic fluid reduces maintenance. The unit may be installed and operated in any position and on moving equipment with choice of foot, base or clevis mountings. The Hydractor provides a flexible source of power; force on both extension and re-

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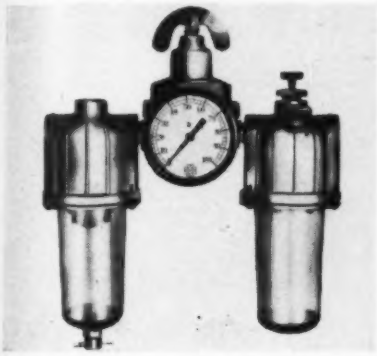
traction strokes is equal; speeds are adjustable; control may be manual, semi-automatic or full automatic; and the unit will stall without damage to itself. These machines are available in capacities from 1000 to 4000 pounds working force at speeds of 3 to 12 ips. The standard stroke is 12 in, although longer or shorter strokes are available. *3.*

CIRCLE NUMBERS ON THE CARD AND MAIL!

Dual Air Control Unit

The Airlube Control Unit, a new dual control for purifying and lubricating low pressure airlines, is announced by Airlube, Incorporated. The unit combines two basic sections with a common regulator and gauge. The Goodyear Pur-O-fier (left) removes oil, moisture and



dirt from air or gas lines by the scrubbing action of a series of impinging baffles and is fitted with a transparent plastic bowl and drainage petcock. The Pur-O-luber (right) provides an adjustable supply of finely atomized lubricant. The unit operates under a maximum of 125 psi. The Pur-O-fier and Pur-O-luber can be supplied for operation as separate units. *4.*

Low Pressure And Vacuum Operating Switch

FASCO Industries, Inc., announce the production of a new, versatile pressure and vacuum switch. Its wide range

of applications include use on indicating and actuating devices for fluid and air pressure systems, and similar uses on vacuum systems. The switch can be made to operate either normally open or closed with pressure settings from 0

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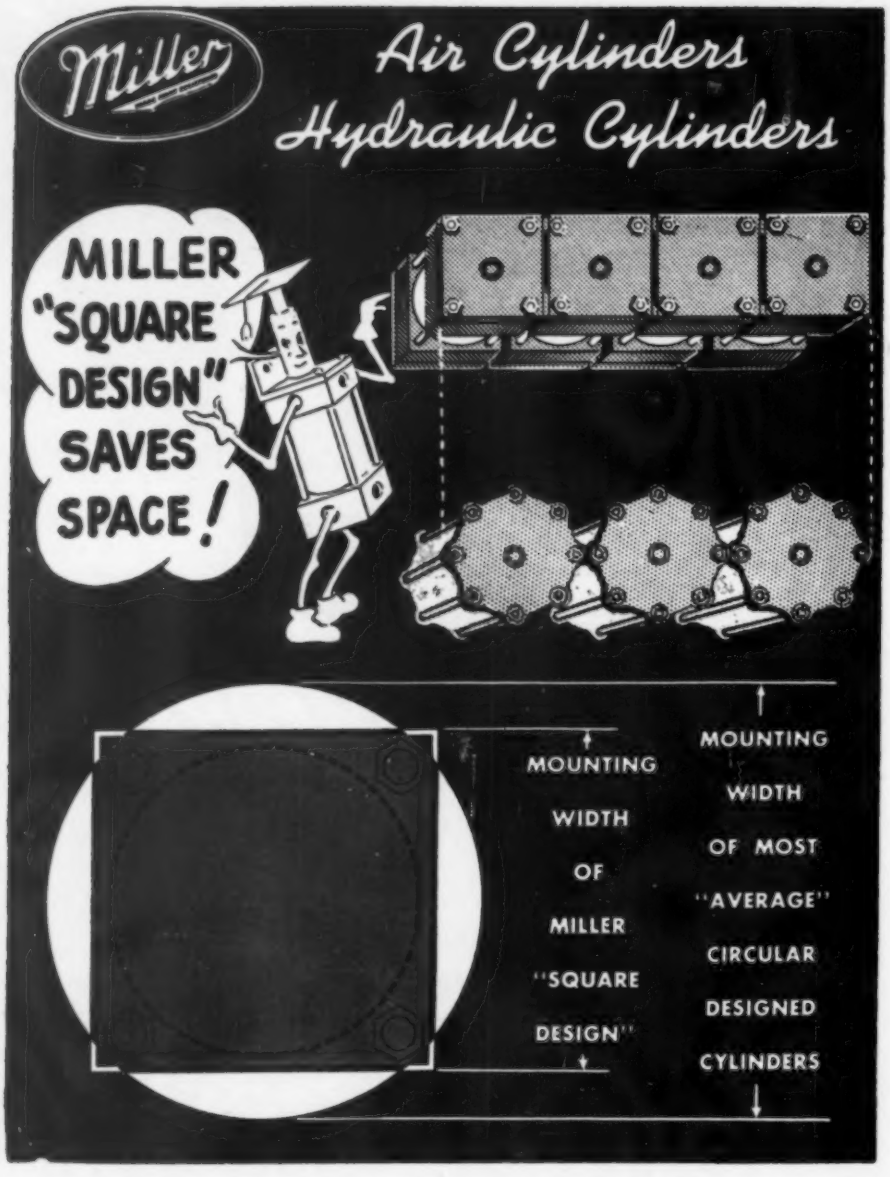
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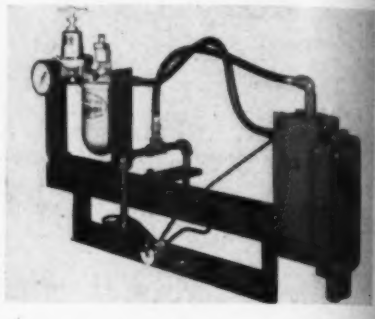
AIR AND HYDRAULIC CYLINDERS - ACCUMULATORS - COUNTERBALANCE CYLINDERS - BOOSTERS - AIR HOISTS

to 50 psi, maximum 200 psi. Supplied with two insulated terminals or one grounded, the switch can be used in systems supplying lubricating oil, air, brake fluids, fuel oils and others. *5.*

Lubricator For T-Beam Conveyor

A lubricator assembly for automatically lubricating bearings in 1¼ in dia



wheels which run on a T-beam, is available from J. N. Fauver Co., Inc. Four nozzles direct oiled air jets to both inside and outside of each wheel bearing, each pair of wheels trip triggers as they pass the lubricator. A regulator with back mounted gauge is used to establish operating pressure of approximately 40 psi; operation is entirely automatic. *6.*

Air Filter-Dehydrator

The Lear-Romec filter-dehydrator, useful for many industrial applications of vacuum or pressure processing systems requiring dry air, is now available in a two tube model according to the manufacturer Romec Division, Lear, Inc. The transparent tubes contain high absorption capacity silica gel of the relative humidity indicating type. A visual scale indicates when the gel must be reactivated or replaced. Four types and sizes of dehydrators may be modified in tube diameter and length for installation requirements. Auxiliary wire mesh screens and filter pads assist in the removal of air dust and foreign matter. *7.*

Improved Wafer Type Valves

Improved, heavy-duty wafer type valves, No. 771, said to have a considerable mechanical advantage over other valves of this type, are offered by R-S Products Corporation. A one piece body casting, handwheel control, self-locking worm and gear and large mounting bracket offer many of the advantages of the standard double flanged units. In the open position the beveled streamlined vanes create a venturi action. Pressure drop is low, showing substantial savings in pumping power. The valves are used for air, gas, liquids, steam and semi-solids in the shut-off and regulation of volume and pressure, pressure relief, control of liquid level, back pressure, water hammer, regulation of pump, fan, engine and turbine output and control of automatic combustion. *8.*

(Please turn to page 38)

SUNVIS 931 GIVES PERFECT PERFORMANCE

Press Free of Rust and Corrosion; Makeup Not Needed; Original Charge of Oil As Good As New After 3 Years

Three years have elapsed since a light-truck manufacturer installed a 350-ton hydraulic press for stamping and drawing tops. In this length of time the original charge of oil . . . 750 gallons of Sunvis 931 . . . has never been changed. Nor has makeup ever been required. Regular inspections prove the oil to be good as new. Furthermore, the press has never shown a sign of rust or corrosion—even after shutdowns for model changes.

Performance like this explains why "Job Proved" Sunvis 900 Oils are in wide demand wherever circulating systems dictate quality. Every oil in the Sunvis 900 Series eliminates oxidation and sludging, prevents rust and corrosion. Sunvis 900 Oils are the finest lubricants available for hydraulic systems, turbines, and similar applications. For a free, illustrated booklet on Sunvis 900 Oils, write Department AH-6.

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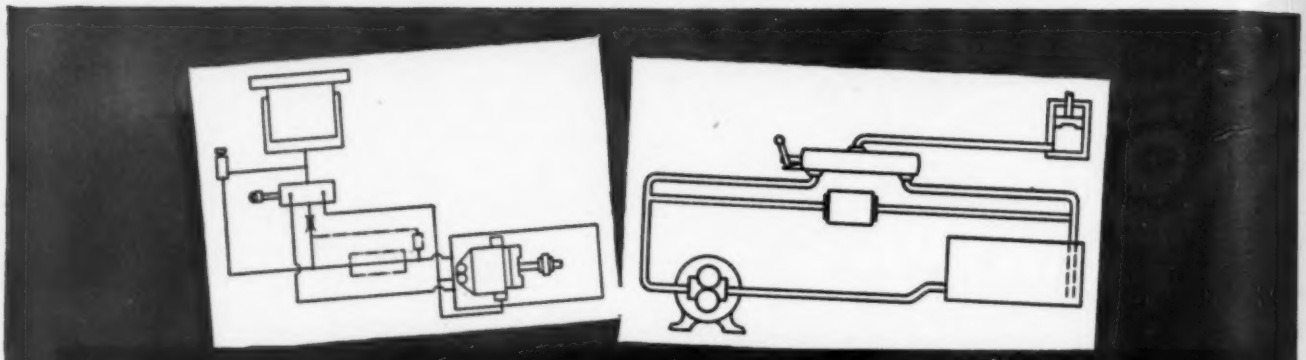
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO®



A Beginner's Course in Basic Hydraulics

CHAPTER VI

COMPOUND AND PRESSURE REDUCING VALVES

Part 3
Pressure Reducing Valves

This series has been adapted from a special text prepared by the Standards and Curriculum Division, Training Bureau of Naval Personnel, United States Navy. This material is used by permission. Any further reproduction use must be authorized by Bureau of Naval Personnel, Department of the Navy.

HOW THEY WORK. Pressure reducing valves are needed when the main line delivers high or fluctuating pressures and a lower constant pressure is required on a branch line. System pressure acts upon a spring, the spring compresses, and the piston moves across the line of flow, blocking pressure down to the figure determined by the adjustment of the spring. Although some pressure reducing valves are really simple valves, how they work can best be grasped after an understanding has been gained of compound relief valves.

Hydreco VA Series pressure reducing valves. Figure 84 shows the design of this valve. Oil under pressure enters through the high pressure port and through hollow plunger A and out through reduced pressure port to point of application. As pressure in inlet chamber increases, plunger A moves up until port C is closed off, resulting in a predetermined static pressure at reduced pressure port. This pressure can be changed by adjustment of spring D. If pressure at reduced pressure port increases, due to minute seepage through plunger bore or check valve F, plunger A will continue to rise, allowing port G to by-pass excess oil to tank via port E. In pressure reducing valves for operating pressures greater than 200 psi a sliding plug is placed in position B to decrease the differential area between top and bottom of plunger A to permit a lighter spring D to be used. In this case, pipe plug BB is omitted.

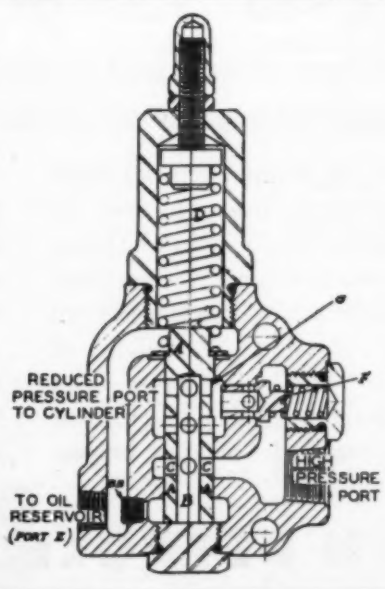


Fig. 84. The Hydreco VA series pressure reducing valve. Normal flow with valve open is through high pressure port, hollow plunger A and out reduced pressure port to work units. Increased inlet pressure moves plunger A up, cutting off port C, giving predetermined static pressure at reduced pressure port. Increased pressure at reduced pressure port causes plunger A to rise further, by-passing oil by a flat on the plunger to port E and reservoir.

Courtesy Hydraulic Equipment Co.

As predetermined pressure at reduced pressure port decreases from cylinder operation or bleeding, plunger A will lower and close off by-pass port G to maintain the predetermined reduced pressure. If the oil pressure from the pump is cut off by a control valve, the inlet chamber is vented and cylinder pressure opens check valve F and vents through the control valve to the reservoir.

If this valve is installed just ahead of any cylinder, even though other cylinders in the systems may be operating at full system pressure, reduced pressure can be supplied to a cylinder which is connected to the pressure regulating valve.

The Hydreco VA series pressure reducing valve is designed for 1000 psi maximum inlet pressure, models for pressure ranges of 100-300 and 200-1000 psi are standard, both with capacity of 15 gpm.

Logan pressure reducing valve. This valve is made in two models, the 8036, the standard reversing flow type and the 8136, identical except that a convenient hand wheel replaces the adjustment screw, Figure 85. Normally, open, the valve permits unrestricted flow of oil until a predetermined pressure is reached.

Model 8036 valve has a floating piston which moves vertically due to the difference in force between oil pressure on the bottom and spring pressure on the top. Initially, the working pressure on the low pressure side is less than the adjustable pressure for valve operation. The piston will be in the down position and the valve fully open. As the pressure increases, due to resistance, the spring on the top of the piston will begin to compress and the piston will rise.

Valve Operation

Normal operation for the valve, Figure 85, is for the flow to pass from the left side to the right. The piston is partially hollow at its base and contains a ball check valve held inside the narrow part of the piston by a screwed-in seat. Small openings admit liquid to the area inside the piston over the check valve. As long as the pressure differential produces flow in this direction, the ball check will remain closed. However, when pressure on the inlet side of the valve decreases below the pressure on the outlet side, the ball check will open; oil will reverse its flow through the valve until pressure on either side is practically balanced, when the ball check valve will be closed by its spring. While flow in both directions is thus obtained, pressure is regulated in only one direction—that not requiring flow through the check valve.

A small needle valve, Figure 85, is provided in the lower cover of the valve which must be adjusted after the pressure control spring in the top cover is set for the required outlet pressure. This needle valve functions to level off the outlet pressure

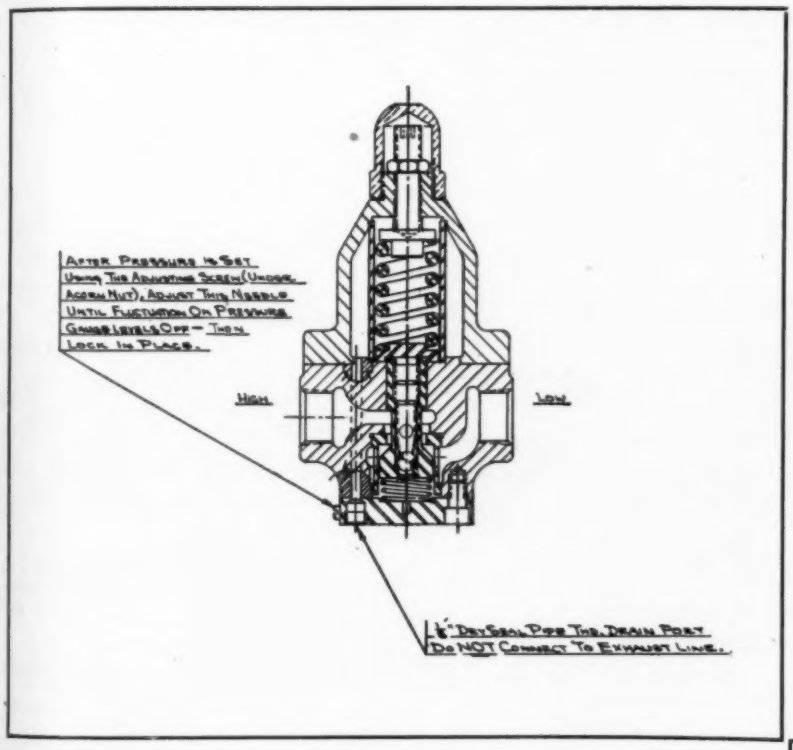

After Pressure Is Set
Using The Adjusting Screw (Under
Acorn Nut), Adjust This Needle
Until Fluctuation On Pressure
Gauge Levels Off — Then
Lock In Place.
High
Low
1/4" Pipe Size For Drain Port
Do NOT Connect To Exhaust Line.

Fig. 85. Model 8036 Logan pressure reducing valve which, by operation of the ball check valve when inlet pressure is reduced, permits reverse flow. The drain from the upper valve body is indicated by dotted lines.

Courtesy Logansport Machine Co., Inc.

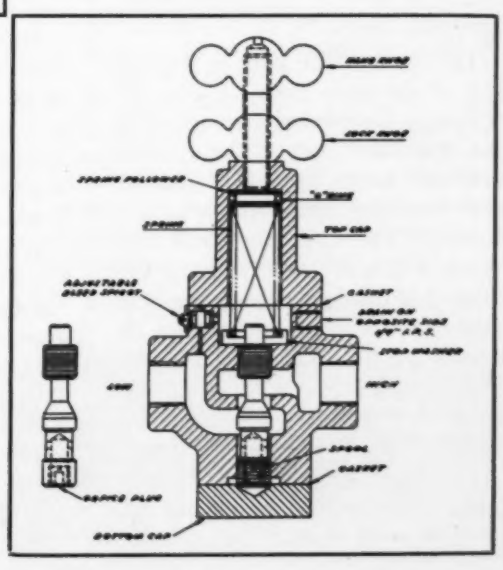


Fig. 86. Model "WW" Double A direct spring type pressure reducing valve. A small amount of oil bled from the low pressure side to the reservoir prevents overtravel and maintains the desired secondary pressure.

Courtesy Double A Products Co., Inc.

and prevent fluctuation of the valve piston when it is nearing the closed position.

The Logan pressure reducing valve must be connected so that the high pressure side of the valve is on the high pressure side of the system. A drain from the conical spring area to dispose of oil that has leaked past the piston into the upper part of the valve must be directly connected to the reservoir. This drain must not to allowed to clog, or high pressure over the piston may blow out a gasket or do more serious damage.

The 8036 and 8136 valves are designed for maximum operating pressures of 1500 psi, sizes from ¼ to 1¼ in, handling capacities from 6 to 50 gpm.

Double A Products Model "WW" pressure reducing valve. This model is a sliding spool type valve with a normally open spool which decreases the orifice between the high and low pressure until the maximum low pressure is attained, at which time the valve closes. A small amount of oil bleeds from the low pressure side to the reservoir to prevent overtravel and maintain the desired secondary pressure.

Return flow through the valve, Figure 86, is possible providing the pressure does not exceed the low pressure setting. The valve may be mounted in any position. Capacities from 6 to 60 gpm in ⅜ to 1½ in pipe sizes to provide adjustable pressure ranges of 75-250, 250-500, 500-1000, 1000-1500, 1500-2000 psi are standard; the primary pressure on the 75-250 psi range should not exceed 1000 psi or 2000 psi on the other ranges. Special models are available for 3000 psi input or primary pressures.

The small orifice plug in the bottom of the main spool, Figure 86, acts as a dampening medium. This is a removable part so that various size orifices can be used in accordance with variations in the circuit involved. The adjustable bleed spigot takes care of variables in oil viscosity and operating conditions. The spigot can be opened to increase the by-pass oil for relief action on light thrust loads.

The next installment will begin Chapter 7 on directional valves. Be sure to save all installments for future reference. Questions on Chapter VI will be found on page 45.

Aircraft Hydraulic and Pneumatic Committee Meeting

SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment, convened on April 19, 20 and 21 at the Park Sheraton Hotel, New York, with more than 100 hydraulic engineers from industry and government agencies present. Chairman B. R. Teree of the New York Air Brake Company presided.

Approximately 35 items were discussed and much progress was made on the standardization of new equipment items for both hydraulic and pneumatic usage. Foremost among these was the final action on the new cylindrical accumulator. Based on results of an industry wide survey, the committee reached final agreement on seven standard sizes covering five cubic capacities from 25 to 400 cu in. Also considered were such design characteristics as moisture drainage, seal lubrication, gunfire resistance and air permeability of the seal materials.

Fred H. Pollard of Republic Aviation Corp. presented a proposed revision to the relief valve specification based on the results of an industry survey and a meeting held the previous day at the Republic plant. The revision added additional classes of relief valves with lower pressure settings and revised paragraphs to clarify and further simplify production testing. With minor revisions, these proposals were accepted.

Harry Cornish of Douglas, El Segundo, presented a new specification for power boosted master brake cylinders. Only minor revisions were indicated by comments before submission to the Services.

Art Hobelman of the Walter Kidde Company presented a proposed revision to specification AN-P-86, the general specifications covering pneumatic systems. He reported the project needed further work including the formulation of several basic decisions. Discussion developed the fact that, while a great deal of pneumatic design information was available, it had never been assembled into a form readily accessible. Steps were initiated to assemble this information into a manual.

Harold Berke of Air Materiel Command reported on current experience on the B-26 which the Air Forces converted from a hydraulic system to a pneumatic system for operation of major accessory functions. The report covered cold weather experience in Alaskan operation.

Considerable discussion again centered around the proper impulse testing requirements for hydraulic systems and units. Since recent experience has proved that many units which have been performing satisfactorily in service would not pass the severe test conditions, which have had a tendency to become more severe. It was indicated that a more logical approach would be to maintain the test pressures at a more moderate level and to concentrate future development toward determining the effect of peak pressures, including such variables as wave form and rate of pressure increase, on the basic elements of hydraulic systems and equipment.

Among other items included for standardization or discussion were: packing installations; small size "O" rings; restrictor valves; flow regulators; slide type selector valves; pressure reducing valves and hydraulic tubing.

Chairmen J. M. Kidd and L. J. Henderson of Committees A-1 and A-3, respectively, submitted reports on the activities of their committees which met earlier in the week.

A-6 Committee members present included: Chairman B. R. Teree of the New York Air Brake Co., B. N. Ashton of Electrol, Inc.; J. W. Kelly of Adel Precision Products Corp.; J. M. Kidd of Glenn L. Martin Co.; H. P. Kupiec of Air Associates, Inc.; J. P. Kovacs of Purolator Products, Inc.; F. A. Lewis of Linear, Inc.; F. W. Murphy of Douglas Aircraft Co., Inc.; F. O. Hosterman of Lockheed Aircraft Corp.; F. H. Pollard of Republic Aviation Corp.; D. E. Leach of Chance Vought Aircraft; W. V. Scholz of United Airlines and R. C. Bumb of North American Aviation.

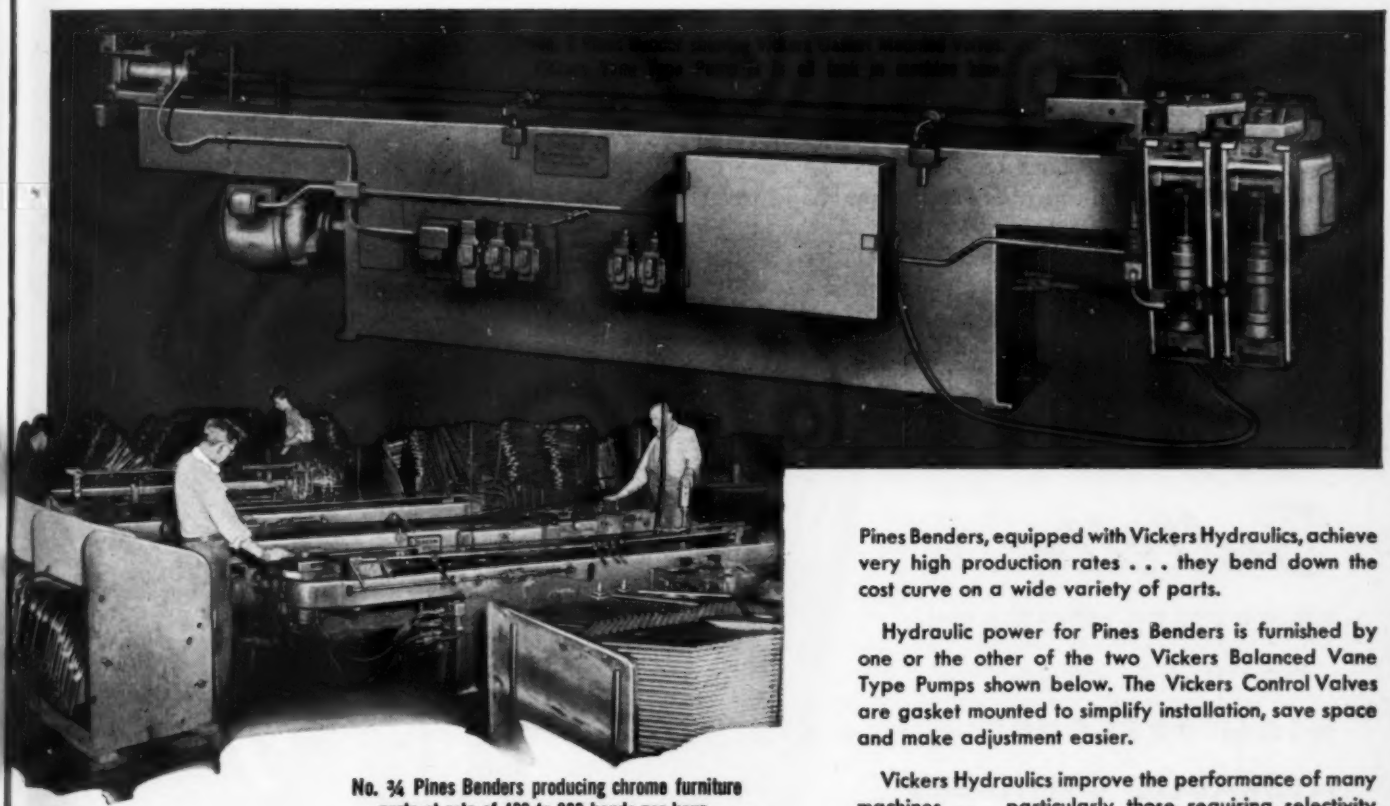
The next was tentatively announced for Los Angeles in late September.

Bending the Cost Curve DOWN

PINES BENDERS

Another Cost-Cutting Application of

VICKERS HYDRAULICS



No. ¾ Pines Benders producing chrome furniture parts at rate of 400 to 800 bends per hour.

Pines Benders, equipped with Vickers Hydraulics, achieve very high production rates . . . they bend down the cost curve on a wide variety of parts.

Hydraulic power for Pines Benders is furnished by one or the other of the two Vickers Balanced Vane Type Pumps shown below. The Vickers Control Valves are gasket mounted to simplify installation, save space and make adjustment easier.

Vickers Hydraulics improve the performance of many machines . . . particularly those requiring selectivity of control and adjustment to suit type of work. Any sequence of motions can be provided . . . made automatic if desired. Vickers Hydraulic Equipment is easily protected against overload; incorrect or unsafe operation can be prevented by interlocks. Contact the Vickers Application Engineering Office near you for suggestions on how Vickers Hydraulics can improve your machinery. Write for Catalog 4900.

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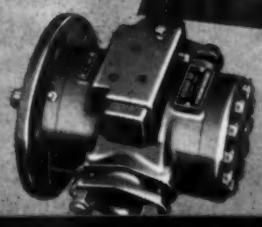
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

HYDRAULIC POWER BY VICKERS

BALANCED VANE TYPE PUMPS

Smaller Pines Benders use this Vickers Single Stage Vane Type Pump (for 1000 psi continuous operation). Hydraulic balance eliminates bearing loads caused by pressure, assuring longer life.



Larger Pines Benders have this Vickers Two Stage Vane Type Pump (for 2000 psi continuous operation) which has two hydraulically balanced pumping cartridges in one compact housing.

AIR CIRCUIT FOR SLOTTING MACHINE

(Continued from page 15)

the corresponding pushbutton. The four-way air valves "N" and "T" are of the double solenoid momentary contact type; hydraulic shut-off valves "J" and "K" are normally closed; all limit switches—"E", "F", "G" and "H"—are normally open. Reversing button is momentary contact; start and stop station has maintained contacts. The sequence of operation is as follows:

Sequence of Operation

Current from the line flows through starter and limit switch "H" (held closed by cam) to solenoid "P" of four-way valve "N" which directs air to the front end of cylinder "B". A rack engaging teeth on the periphery of the index head is pulled backward and turns the head through a 90 degree movement. At the end of its stroke, rod of cylinder "B" closes limit switch "E" to energize solenoid "R" of four-way valve "T", admitting air to the rod side of cylinder "D" and the lower side of cylinder "A". The motor unit is tilted to the position shown so that the cutter height is maintained to a definite dimension regulated by the adjustment screw. The table now enters the rapid approach stroke. It is pulled to the right by cylinder "D" and the indexing head which is integral with it draws away from the rack and becomes automatically locked in position by a spring loaded cam which holds it rigid during the cut. At this point valve "J" opens by cam actuation but does not function at this stage. Immediately prior to cutter contact the table slows down to feed speed as a result of cam clearing the valve "K" which causes it to close. Cylinder "D" now meets with resistance from the oil flow in cylinder "C" and travels at a rate governed by the setting of the hydraulic metering valve "M"; oil on the head side of cylinder "C" returns to reservoir.

As the table proceeds to the right limit switch "F" is closed and energizes solenoid "Q" to reverse valve "N" and the rack, since limit switch "H" has opened to clear the opposite side of the circuit. While the work is passing slowly through the cutter the index head is re-loaded. After the cut has been completed a cam on the table contacts limit switch "G" to energize solenoid "S" and reverse valve "T". (Note that "E" has been opened by return of rack). Piston of cylinder "A" now moves down lowering the motor with it under gravity and raising the cutting wheel in order that it will be clear of the work during the return movement of the table by cylinder "D" which is also effected by the reversal of valve "T". The return stroke is cushioned by the closing of valve "J" and needle valve "L" during the re-engagement of the rack teeth with those on the indexing head.

Air at low pressure in the oil reservoir serves to prevent atmosphere from being drawn past the rod packings. The check valves allow free oil flow from the reservoir to the low pressure side of cylinder "C". Upon completion of the return stroke starting cam closes limit switch "H" to repeat the cycle.

New Bulletin

PRESENTS NOPAK "SERIES 1500" HIGH PRESSURE HYDRAULIC CYLINDERS

Designed for heavy duty service at high pressures, the New 1500 Series embodies features which contribute to long-range dependability and trouble-free operation. Included are: Positively Locked Piston Assembly, Tubing Flanges secured by Lock-Rings, Compensating Rod Wipers, "O"-Ring Static Seals between heads and tubing. Available in 5 standard mountings, with or without Adjustable Cushioning.

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DESIGNED for AIR and HYDRAULIC SERVICE

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. . . use the oil seal that's designed to save space!

Only 2 simple parts:

The Johns-Manville Clipper Seal consists of only two parts—a one-piece concentrically moulded body and a specially designed garter spring, factory assembled into a single, compact unit. Available in both split and endless types.

THIS EXPLODED VIEW of the revolutionary, new Sier-Bath Gear Coupling shows how Clipper Seals helped one enterprising manufacturer achieve simplicity and compactness in the design of his product.

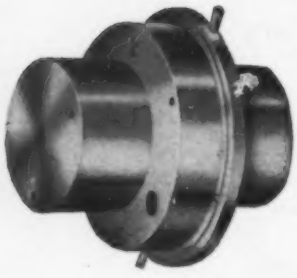
The result is a thoroughly streamlined gear coupling—comprised of a few simple parts—that is so simple that it can be taken apart—and reassembled—in a few minutes.

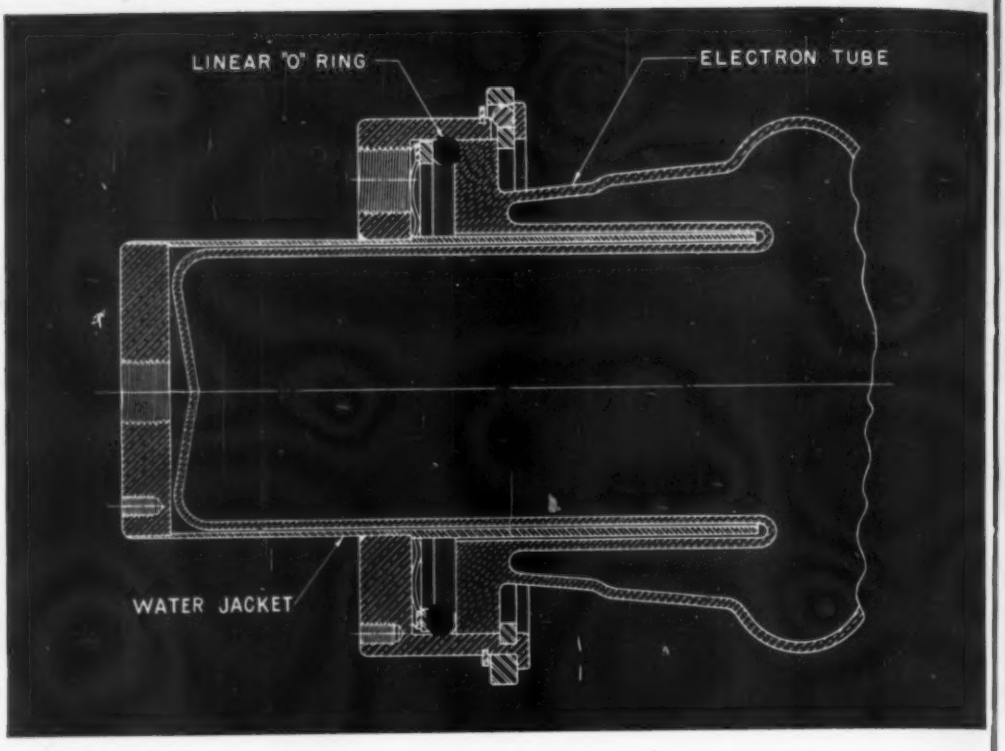
Clipper Seal's simple design provided important space-saving advantages that helped make this possible. Seals of a narrow flange section were used to permit making the oil seal cavities of minimum depth. Composed of a rigid heel and a flexible lip moulded as a single unit, each seal does an efficient job of retaining oil and excluding dirt, moisture and corrosive fumes—and does this job in a minimum of space.

If you are looking for an oil seal that will help streamline your product, it will pay you to investigate Clipper Seal's many advantages. They are available in various lip designs to provide a choice of bearing surfaces, in sizes to fit shaft diameters from ⅜" up to 66" and for temperatures up to 450 F. Just write Johns-Manville, Box 290, New York 16, N. Y. Ask for brochure PK-46A.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS





TIP...

FOR THE DESIGNER

Keep it simple...with

LINEAR PRECISION MOULDED "O" RINGS

Machlett Laboratories had the problem of making their new industrial electron tube water jackets easy to remove for necessary inspection and safe against maintenance error.

This required the use of a seal of many characteristics. It had to be *simple—permanent—non-adhesive to the anode wall—fool-proof*—and last but not least, *absolutely leak-proof*.

A LINEAR O-RING SEAL met these requirements. Under pressure it is leak-proof, and the seal can not be broken until the pressure is released—making it fool-proof. Requiring no replacement, it is permanent. Maintained with hand-tight pressure and no adjustment, it is non-sticking. Requiring no tools for assembly or disassembly, it is simple. That is the story of the LINEAR O-RING.

This and many thousands of other sealing application problems have been solved with LINEAR precision moulded O-Rings. For specific help with *your* sealing problem—CALL LINEAR.

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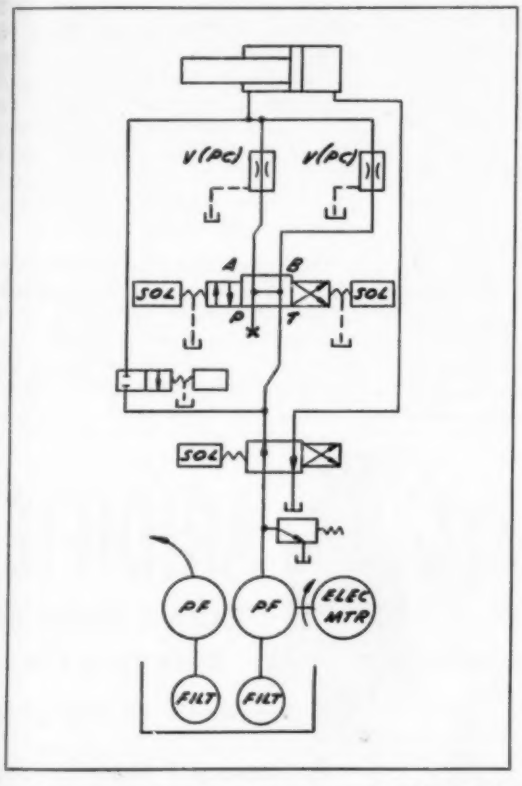
HERE'S HOW

- PREVENTIVE MAINTENANCE
- SERVICE PROCEDURES
- MODERNIZATION
- SHORT CUTS

Three Feeds in Boring Machine Circuit

THIS CIRCUIT is a part of a double end boring machine hydraulic system. While one end is machining a critical operation, this portion of the circuit roughs, semifinishes and finishes a bore whose finish is not critical, but whose concentricity must be held. Each of the three operations requires a separate rate of feed, which is provided by two flow control valves operating through an open center, four-way control valve. The accompanying circuit shows that



the rough bore makes use of the flow of both flow control valves through the open center position of the spring centered, solenoid operated, four-way control valve; semifinish through T to A ports; finish bore through T to B ports. Rapid approach and return is controlled through a solenoid operated two-way valve.

W. T. MCCORMICK
Peoria 5, Illinois

Eliminating "O" Ring Spiral Failure

WHEN AN "O" ring twists and becomes cut and torn, spiral failure occurs. While this type of breakdown is not common, some installations find spiral failure to be an operating problem. It usually occurs on a gland that has an exposed rod passing through the "O" ring. Where spiral failure is encountered, following points should be checked:

1. A felt or rubber wiper ring should be provided on the dry side of the "O" ring installation. This serves to wipe off the dirt, more important, it provides adequate lubrication for the "O" ring by spreading the minute leakage at the ends of the stroke over the dry surface.

2. The "O" ring compound must be stress-age resistant. The Army-Navy "crush test" in specification AN-P-79 is believed to be the simplest and quickest test.

3. In pneumatic systems the proper grease will do the trick. Some greases now available are reported to last the life of the installation.

4. The surface finish of the metal over which the "O" ring passes should be less than 15 microinch roughness.

TOMMY J. MCCUISTON
Cleveland, Ohio

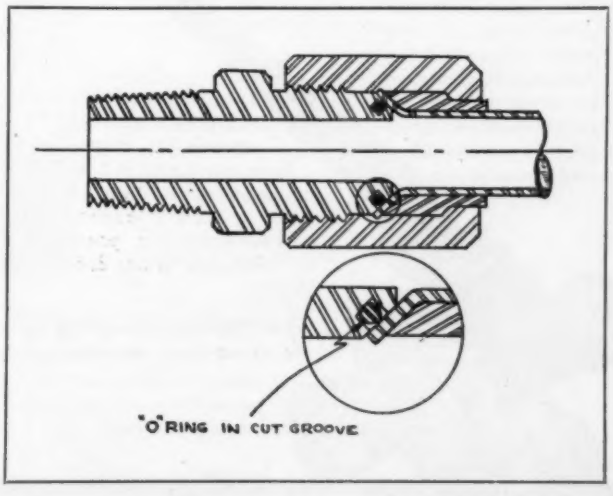
A Second Answer to "Hydraulic Dashpot"

ONE OF THE PROBLEMS presented by Mr. E. F. Heiser in the February issue concerns a method for determining the profile dimensions of a hydraulic metering needle in a dashpot. We have prepared an analytical analysis of this problem as it applies to a metering needle used for the snubbing action in a landing gear retracting cylinder. Although this approach must be custom fit to the individual problem, basic momentum and energy principles are applicable in all cases. While an empirical approach is practical, the mathematical method provides us with a needle which can be reproduced. The success of the device largely depends upon the accuracy of manufacture.

HARRY P. KUPIEC
Teterboro, New Jersey

"O" Ring With Flared Fitting

FOR HIGH PRESSURE applications, ranging up to 10,000 psi, it is sometimes difficult to seal a hydraulic connection which must be made in a tight place with a short bend.



By using a small "O" ring on the connector, a standard one reworked or a newly made piece, it is possible to seal the larger size tubing where an ordinary flared joint would leak. The groove must be carefully cut, the outer edge being important for sealing.

WOODROW L. WROBLE
Schenectady, N. Y.

Useful Literature

The publications listed are available without charge. Mark the initial key number on the card bound in this issue and mail.

28. Reusable Steel Hose Ends . . . The new 20-page catalog H-1451 gives full information on the new reusable steel hose ends and five types of industrial hose and hose assemblies made by The Weatherhead Company. Design advantages, specifications and assembly instructions are given in detail. Ordering nomenclature and parts numbers make the catalog easy to use.

29. Condensed Catalog . . . A new 8-page condensed catalog issued by The Oilgear Company gives a quick overall of their variable and constant delivery, duplex and feed pumps, variable speed transmissions, constant and variable displacement motors, standard and heavy-duty cylinders, standard controls, pilot and directional control, relief and foot valves. Bulletin 10051 is an excellent index to the rather voluminous, detailed literature necessarily published by this company.

30. Hydraulic Control Valves . . . Catalog 85, issued by Logansport Machine Co., Inc., covers the extensive line of standard oil hydraulic valves offered by this company. A full line of two-position, two-, three- and four-way valves, three-position, four-way hydraulic valves, pilot, solenoid, cam and foot operated control valves, all for 1500 psi oil service, are illustrated and complete specifications listed. High pressure oil (2500 psi), water service (1500 psi) and accessory valves are shown. A number of typical circuits are also shown.

31. Centralized Systems of Lubrication . . . Bulletin No. 25, issued by The Farval Corporation, describes the Farval positive mechanical method of delivering oil or grease under pressure to a group of bearings from one central station, in exact measured quantities and as often as desired. Both the manually operated central pumping unit and the automatic central pumping units are described, as well as the Farval Dualine measuring valve installed at each bearing or lubrication point. A number of standard manual and automatic systems, heavy-duty and junior systems and the Multival unit are illustrated, installed on a wide range of industrial machines. Fittings and accessories required for any application of Farval centralized systems are also shown.

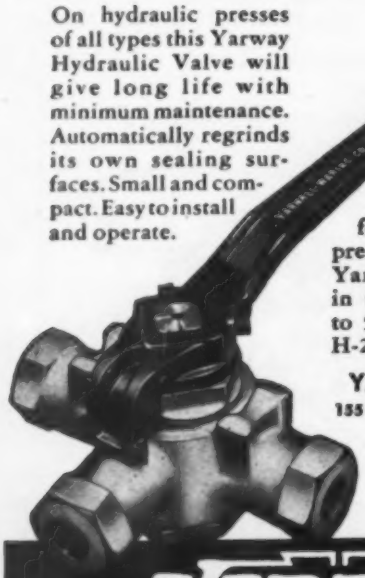
32. Packaged Air Controls . . . Specially prepared for the ASTE show by Beckett-Harcum Company, Inc., Bulletin No. 30 pictures and describes applications of packaged unit for the air control of drill presses and of cut-off saws. The package units, specially designed in each case around the "Hi-Cyclic" valve and combining a central and unitized control panel, two balanced cylinders for drill presses or one cylinder for cut-off saws for operation at not more than 40 psi, are described in detail. Separate additional data on the "Hi-Cyclic" valve with built-in directional speed control and of the control panel are given.

33. Felt Seal Design and Application . . . An 8-page technical bulletin, Data Sheet No. 11, "Felt Seals, Their Design and Application", published by American Felt Company offers basic engineering information on the types and selection of felt seals. A number of plain and laminated felt seals and housing designs are illustrated. Tables on oil absorption capacity of SAE felts and dimensional tolerances and degree of housing compression for plain and laminated felt seals are included.

34. Condensed Catalog . . . A new 8-page catalog of the Gerotor line of air and hydraulic cylinders, air and hydraulic valves and hydraulic power units has been issued by Rivett Lathe & Grinder Inc. In addition to many of

The Higher the Pressure ...the Tighter the Valve

On hydraulic presses of all types this Yarway Hydraulic Valve will give long life with minimum maintenance. Automatically regrinds its own sealing surfaces. Small and compact. Easy to install and operate.

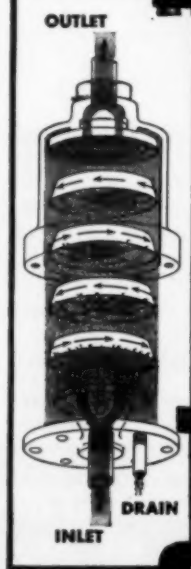


Yarway Single-Pressure Hydraulic Valves are made in straightway, three-way and four-way types; in five sizes for pressures up to 5000 lbs. Also Yarway Two-Pressure Valves in two sizes for pressures up to 5000 lbs. Write for Bulletin H-210.

YARNALL-WARING CO.
135 Mermaid Ave., Philadelphia 18, Pa.

YARWAY
Improved Type
HYDRAULIC VALVE

Let The ARIDIFIER
CLEAN YOUR AIR AND GAS LINES
Removes 92% Oil, Water and Dirt



The Aridifier gives you positive removal of oil, moisture and other foreign matter from air or gas lines. With paints and lacquers it often eliminates bloom and imperfections in finish. It provides dry lines for ceramics, sand blasting, for air cleaning, etc. Wherever the need exists for *dry* clean air or gas, the Aridifier delivers the goods. Easily installed. No maintenance problem. 10 models available. Capacity range: As low as 7 CFM to 17,000 CFM.

BULLETIN 147 Tells The Complete Story

HOW IT WORKS — Exploded view shows how four multi blade rotors revolve at high speed in opposite directions under impact of air movement through non-aligned rotor spaces. Moisture, dirt and other foreign matter which collect on rotor blades are thrown out of air stream by centrifugal force to side of housing, and pass into drain.

Made By The Manufacturers of Logan Lathes and Shapers.

Logan ENGINEERING CO.
4920 W. LAWRENCE AVE., CHICAGO 30, ILL.

the standard units, a number of representative circuits are shown and Gerotor distributors are listed.

35. Tube Deburring Files . . . A new bulletin, No. 341, issued by Grobet File Company of America, Inc., describes the Grobet combination outside and inside tube deburring rotary files. Made of high speed steel and ground from the solid after hardening, the deburring files are adjustable to increase or decrease the relative amount of chamfer between inside and outside wall tubing. Standard files make a 45 degree chamfer on outside wall and a 30 degree on the inside wall of tubing.

36. Filtration Service . . . Form No. 1148, issued by The Cuno Engineering Corp., is a condensed bulletin describing briefly the three types of industrial filters made by this company. The Auto-Klean filters, which employ the principle of edge filtration plus positive mechanical cleaning; the Flo-Klean filters, which utilize the principle of backwash filter cleaning with no loss of fluid; and the Micro-Klean filters, with replaceable micronic filter type cartridges are described, pictured and capacity tables are given. The Micro-Klean air line filter is also shown.

37. Pump Pulsations . . . Bulletin 500, a new technical research paper dealing with pump pulsation problems, has just been issued by Greer Hydraulics, Inc. Pressure surges developed by the pulsating action of piston type system pumps are the commonest cause of pipe line and hydraulic system failure. The pump pulsation problem is treated in detail, typical types of pumps are illustrated and flow velocity diagrams of their output given and simplified formulas for determining the sizes of Greer hydropneumatic accumulators necessary to obtain optimum dampening are listed. Four of the most common piston type pumps are used as examples. Graphic solutions are also shown.

38. Centrifugal Castings . . . American Non-Gran Bronze Co. has just issued a 16-page two-color booklet entitled "Our Story in Pictures", which illustrates the contract manufacturing facilities of the company for precision machine work, bronze and centrifugal castings and other products. Parts that require an extremely dense and compact structure are being manufactured by the company.

39. Pneumatic Cylinders . . . An application sheet released by Ledeen Mfg. Co. describes the application of pneumatic cylinders to a lumber trimming machine. Pneumatic control permits the raising and lowering of each saw at a rate of 40 times every minute.

40. Bearings and Maintenance Bars . . . A handy pocket size Catalog No. 480 listing Buckeye fully machined maintenance bars, solid maintenance bars and standard sleeve type bearings is available from the Buckeye Brass and Manufacturing Co. The catalog is

PALMETTO®

patterns a ring on a square

for sturdier
vee-packing performance

In designing Pyramid® Packing, Palmetto Packing Specialists patterned each ring on a square—to gain the balance of a uniform cross section (each ring sits squat and true . . . there's no chance of cocking or rolling)—to gain the strength of heavier and uniform wall construction (each ring is rugged at the hinge—there's no chance of damage through splitting).

Another plus in Palmetto's balanced design: Two-thirds of the lateral packing surface is sealing surface—which means fewer rings per stuffing box.

And this is just a part of the job accomplished by Palmetto Packing Specialists for improved and prolonged vee-packing performance.

Fig. 1

Fig. 2

Because most vee-type packings are laminated, wearing surfaces tend to fray and cause leakage. No chance of that here, for the fabric is folded endlessly into a square (Fig. 1), then molded (Fig. 2), leaving no raw edges to wear, break down and impair efficiency.

The Pyramid is a step and a half ahead of all vee-type packings in design and performance . . . insures automatic, self-compensating packing adjustment to all variations in pressure . . . performs in any stuffing box regardless of motion of rod, shaft or plunger

For the complete facts—the 7-point Design story on Palmetto Pyramid Packing . . .

WRITE FOR BULLETIN MP-20

Palmetto's design of *complete* vee-packing performance is typical. Investigate the "Pyramid" . . . the "G-T Ring®" . . . other packings in the complete Palmetto line. When you have a tough one, think of the Palmetto Packing specialist. He'll have the answer—and it will always be Palmetto-Perfect.

PALMETTO Packings *Specified since 1880*

"WHEN PACKING PERFORMANCE COUNTS"

GREENE, TWEED & CO.
NORTH WALES, PENNSYLVANIA

a handy reference guide to progressive size listing of over 1000 standard stock bearings; numerical listing of standard stock bearings; over 250 sizes of 13 in fully machined maintenance bars; and special operations which give data on drilling and grooving for oil or grease lubrication and grooving and graphiting of standard bearings.

41. Metallic Packing . . . A four-page circular issued by Hydraulic Accessories Company lists the "Monopak" line of plunger, rod and piston ring styles of sealing rings. Both standard and segmented types of rod and plunger rings are shown.

42. High Temperature Lubricating Oil . . . Swan-Finch Oil Corporation has just issued a data sheet, No. 1-IL, on their Safco No. 1250 Hi-Temp Oil, a new high temperature lubricating oil. Developed to meet a serious demand for a lubricant for ball and roller bearings—as well as journal bearings—the oil is said to have been "heat-treated" for greater thermal stability, i.e., greater resistance against gum, sludge or carbon formation.

43. Hydraulic Cylinders . . . Bulletin HC-1, published by Galland-Henning Mfg. Co., describes and gives full specifications for the "Nopak" Series 1500 hydraulic cylinders. Available in five models for any application operating at 1500 psi, in diameters from 1½ to 8 in, the cylinders are furnished as non-cushion or with adjustable cushion on either or both ends and with either standard or oversize hardened rods. Chrome plated piston rods and tubing walls for water service are also offered.

44. Automatic Air Separator . . . Bulletin No. 1930, issued by Railway and Industrial Engineering Co., describes and gives full engineering data on their line of "Stuard" automatic air separators. The principle of operation, suggestions for installation on air lines and a list of typical applications are included. The size range will take care of practically every industrial requirement.

CIRCLE NUMBERS ON THE CARD AND MAIL!

45. Ram Speed and Stroke Time Chart . . . The Sinclair-Collins Valve Company has prepared a Ram Speed and Stroke Time Chart to be used in conjunction with their two-pressure valves. The chart gives ram speed in inches per min and stroke time in sec for pressures of 100 to 1000 psi for ram diameters of 8 to 36 in. The nomograph type chart is prepared on a sales kit or file size sheet for convenience. Sinclair-Collins two-pressure valves, properly selected, have been reported to increase ram speeds over 50 percent.

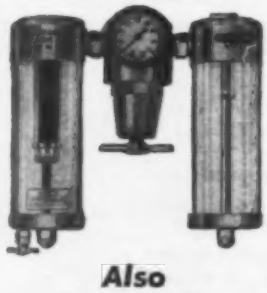
46. Industrial Air Controls . . . A 12-page bulletin on Bendix-Westinghouse industrial air controls has been issued by Bendix-Westinghouse Automotive Air Brake Company. In addition to the Robotair Chamber, Rotochamber diaphragm-type units, valves, filters and other accessories are shown. A feature is selection charts, one for Robotair, the other for Rotochamber, to determine exact sizes for specific applications.

47. Switch Mechanisms and Switch Housings . . . Section II of the new catalog of Magnetrol Inc., a Division of Fred H. Schaub Engineering Company, Inc., illustrates and describes the five basic switch mechanisms used in Magnetrol control units. Operating principle of each type is detailed and illustrated. Construction features of standard, splash proof and explosion proof housings for each type are shown.

48. New Products . . . Hannifin Corporation announces that the special pocket-sized, twelve page booklet, specially produced for the ASTE Show, is available for those who did not attend. New Products described include two "Effortless" air control valves—Type NF for foot operation and type NH for hand operation; the "Micrometric" speed control valve and the "Directair" solenoid operated air control valve. The half ton air operated "Han-D-Press" and one ton hydraulic "Han-D-Press", the Hannifin line of pneumatic and hydraulic cylinders, the "Air Warden" filters, regulators and lubricators are also shown.

"M-B" AUTOMATIC
Air Line FILTER, REGULATOR and LUBRICATOR ASSEMBLY

"Sentinel of the Airline"



FILTER element removes solids .00039 and larger. TRANSPARENT BOWL provides visibility. REGULATOR is capable of passing large volume with an unrestricted flow and minimum amount of pressure drop. Self-bleeding, compact, simple. Machined from bar aluminum. LUBRICATOR delivers desired volume of oil. Adjustable Venturi Valve permits efficient operation on broad range of volume and pressure. Bowl can be refilled without shutting off air supply. Any of these 3 devices can be used as separate units or in any combination.

Also Pneumatic Grinders

Remember, Built-in quality remains long after first-cost disappears

M-B PRODUCTS
130-134 E. Larned St.
DETROIT 26, MICHIGAN

introducing the NEW
Modernair TRADEMARK AIR RETURN AIR CYLINDER

◄ Your Choice of Mounting Brackets
(Mounting must be specified on order)

No Springs to Break!
Replacement of "O" Rings Renews Cylinder Completely

This revolutionary double-acting cylinder is operated with a single-acting three-way valve. Fast forward thrust without the use of quick release valves is made possible due to total absence of springs or air to be compressed.

There is no residual pressure on the forward stroke. The return stroke is made at 60% efficiency using a three-way valve. Speed can be perfectly controlled on both strokes.

Though it is, in effect, a double-acting cylinder, it requires only half the volume of air needed to operate a double-acting cylinder.

For light punch and die work, Modernair cylinders are piston keyed to eliminate rotation.

Patent Applied for.

Aluminum head construction; hard-drawn, relief-annealed brass tubing; stainless steel piston rod. 1⅛-in., 1¾-in., or 2½-in. bore sizes.

FOR DESCRIPTIVE BULLETIN — WRITE:

Modernair TRADEMARK CORPORATION
4222 HOLLIS STREET · OAKLAND 8, CALIF.

CUTTING DOLLARS OUT OF A ROLLING SCHEDULE

(Continued from page 11)

eration of the hydraulic circuit. First, different pressures were required at the two rolls. This was achieved by using pressure reducing regulator valves. Second, identical speeds were required on the two middle roll cylinders which were differentially loaded. This was accomplished by flow control valves with integral pressure compensators. Third, the middle roll had to lower by its own weight on an exact time schedule. This was done satisfactorily by the use of a 1½ in control valve, selected to keep friction to a minimum.

Step-by-Step Procedure

Initially, as the operation begins, both rolls are up, ready for the first pass. This means the first pass is made between the middle and lower rolls and both tilting tables are in the down position. After the first pass is complete, the tilting tables lift. As the tables start their lift, contacts are made to energize the proper solenoid on the two-position control valve which exhausts the middle roll cylinders to the tank. An adjustable choke in this line to the tank controls the speed. The middle roll drops the same distance after the same pass as it was raised for the beginning of the cycle.

At the same time the screw mechanism operates to lower the top roll the amount of reduction to be taken on the next pass (Table 2). As the pressure reducing valve to the top roll is unidirectional, the oil from the top cylinder is exhausted through the relief valve to the tank. The system is ready for the second pass.

After the second pass is complete, the tilting tables lower. As they start their drop, a contact is made to energize the other solenoid on the two-position control valve which opens pump and accumulator to the middle roll cylinders through the flow control valves.

Simultaneously, the screw down mechanism is again forcing the top roll down.

The procedure is repeated alternately. After the seventh pass, the screw downs are raised and both rolls are raised in preparation for the first pass on the next slab.

"O" RINGS SINCE 1941

Outstanding by nature—Parco Balanced Compounds + precision moulding make the outstanding hydraulic packing. For "O" ring packing, investigate "O" rings from Parco Balanced Compounds. All dash numbers of both 6227 and 6230 series for commercial application or Army-Navy installations to Specification ANP 79 are available from stock.

Catalog and engineering data on request. Write us today.

Copyright 1950

Parco

Plastic & Rubber Products Co.

2100 Hyde Park Blvd., Los Angeles 47, Calif.

919 N. Michigan Ave., Chicago, Ill.

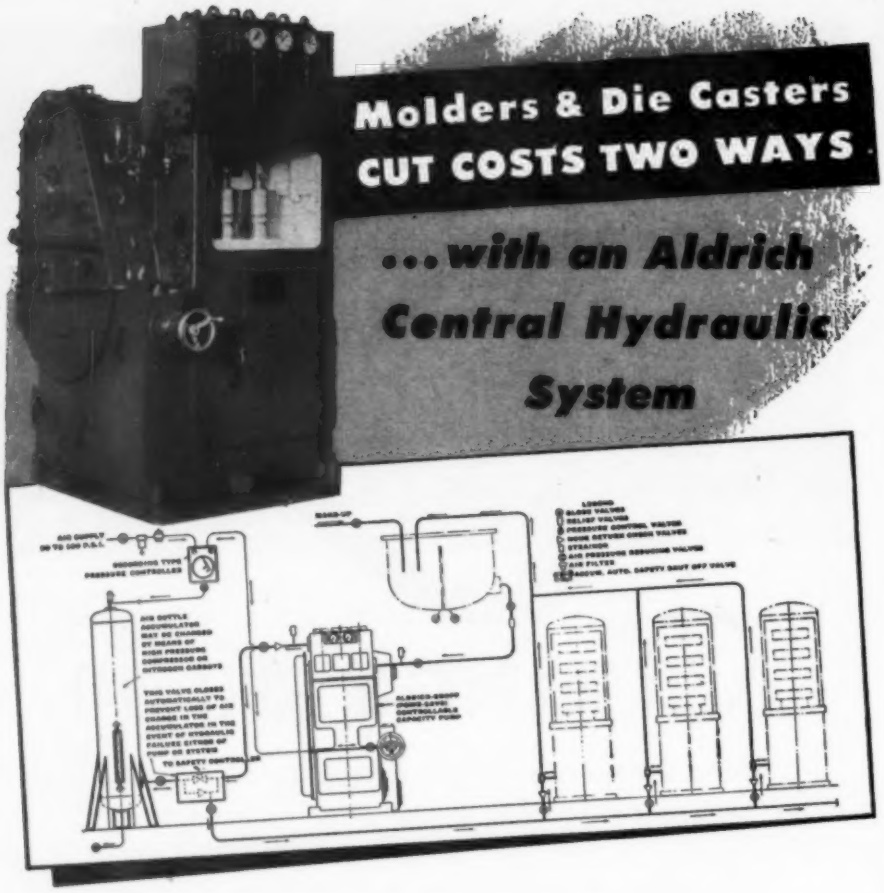
The rolls are kept cool by heavy raw water sprays (Figure 3). Laminated phenolic bearings are water lubricated.

The installation problem was simplified by assembling all the valves, gauges, accumulators, etc., on a fabricated steel valve panel. This is shown in Figure 4. This arrangement has proven particularly convenient since a number of valves required external pilots and external drains. To complete the installation, it was necessary only to pipe from the power unit to the panel and from the panel to the cylinders.

The "shakedown" to satisfactory operation of the system was relatively simple. The system operated as designed, although it was determined that the theoretical frictions of the roll movements had been figured slightly low. This was ironed out by a slight increase in the system pressure to provide more snap and a faster response in the operation. Some difficulty was experienced initially with the perennial bug-a-boo in piping—pipe scale. However, after the system had been purged, operation has been satisfactory.

Ideas Pay Off

Your "Here's How I Do It" idea may be worth $10.00. Jot it down or sketch it and send it to the Editors. All Ten Dollars for your "Here's How" articles published will be worth $5.00 and the best of the month $10.00.



Molders & Die Casters CUT COSTS TWO WAYS

...with an Aldrich Central Hydraulic System

By AUTOMATIC ECONOMY: Through close automatic control of pressure, the Aldrich-Groff Controllable Capacity "POWR-SAVR" Pump supplies *only that hydraulic power actually needed.* Delivery is in almost direct proportion to demand. A simple and reliable stroke regulating mechanism controls capacity in straight line variation from zero to maximum — *at constant pump speed.* Pumps are built in six sizes, ranging from 2 to 6 inches in stroke and from 5 to 125 bhp. Working pressures are provided up to 15,000 psi. The automatic stroke regulating mechanism eliminates start-stop operation, compensates for variation in demand, and affords substantial savings in power.

By SYSTEMATIC ECONOMY: *One* Aldrich-Groff "POWR-SAVR" Pump can supply hydraulic pressure for *all* your press requirements. Many satisfied users of Aldrich Central Hydraulic Systems have cut costs through: minimum investment for equipment, minimum maintenance and repair, and lower operating costs — effected by the higher efficiency of a *single, reliable, unified source* of hydraulic pressure.

For complete details, write — without obligation — to The Aldrich Pump Company, 14 Gordon Street, Allentown, Pa.

Representatives: Birmingham • Bolivar, N.Y. • Boston • Buffalo • Chicago • Cincinnati Cleveland • Denver • Detroit • Duluth • Houston • Jacksonville • Los Angeles New York • Omaha • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. St. Louis • San Francisco • Seattle • Spokane, Wash. • Syracuse • Tulsa

THE ALDRICH PUMP COMPANY

14 GORDON STREET, ALLENTOWN, PENNSYLVANIA

All Aldrich Pumps Have **STAYING POWER**

LETTERS to the Editor

I have a need for small hydraulic pumps of about one-quarter gpm or less at about 1750 rpm with pressures up to 500 psi. Also small one-way valves, solenoid or hand lever operated. Can you give me the names of companies who can supply such pumps and valves?

V.R.H.
RR #3,
Shawano, Wis.

The names of several manufacturers of both pumps and valves with characteristics of small pumps and valves they regularly supply have been forwarded to you.

I read with much interest your article in the February issue of APPLIED HYDRAULICS on "Harvesting Ice by Fluid Power". There are a few questions which present themselves concerning the hoisting circuit. The first is the setup of the electrical circuit of the double solenoid operated four-way valve. The second has to do with the fact that the lever for raising and lowering the hoist actuates the flow control valves, so that it would seem that raising and powering is a function of volume rather than direction of flow, which would be controlled through the solenoid operated four-way valve. Third, I have assumed that the two-way valve is used to unload the pump and that the flow control valve between the four-way valve and the rod end of the cylinder is used to compensate for differences in volume between blind and rod ends.

M.L.

The author answers by quoting from Fred H. Wells, the mechanical designer of the unit. In reply to the first question, Mr. Wells states that there are two double circuit micro switches inside the lever control station, located in the operator's cab, so that when the lever is raised, one micro switch closes circuits to both the pump starter and the solenoid operated four-way directional valve so that the load will be raised. Similarly, when the operating valve is moved beyond neutral in a downward direction, the pump motor starter is again energized, together with the opposite solenoid of the four-way valve so that the load is lowered.

In answer to the second question, it might be helpful to remember that the functions described under the first question occur as soon as the operating valve is moved slightly above or below its neutral position. At this point, the flow control valves are still closed or only slightly open; if the control lever was not moved farther from neutral than is necessary to start the pump and operate the four-way valve, little if any

change would occur in the position of the load. Since the operating lever is also connected mechanically with the spools of the flow control valves, the farther the lever is moved from its neutral position the wider the flow control valves will open. A controlled speed of raising and lowering must, of necessity, be a function of both volume and direction of flow. Actually, there are two systems and circuits, one for raising and the other, although using some common lines and valves, for lowering.

When raising the load, consider the pump as an energy source which delivers fluid through a four-way directional valve, to one flow control valve, and to the rod end of the hoisting cylinder. During this operation, fluid behind the piston (blind end of cylinder) is discharged at zero pressure through the four-way valve to the tank. However, while lowering, we must consider the suspended load itself as the source of energy. This is represented by pressure developed in the rod end of the cylinder; when the load is in a downward motion the piston is delivering fluid through the other flow control valve, through the four-way valve to tank. During the lowering motion the pump merely supplies the difference in volume required to fill the blind end of the cylinder or the "makeup". When there there is no suspended load, the pump, of course, becomes the energy source for moving the rod. If it were not inconvenient to extend the rod manually for cable adjustments, etc., a single acting cylinder would suffice.

In answer to question three, the two-way or through valve was placed in a short circuiting line between the rod end and the blind end of the cylinder and, when open, provides a greatly accelerated downward motion necessary to spill the ice cakes from their containers as they are tipped on a crane operated ice dump. This valve, solenoid controlled and actuated by limit switches, makes the high speed lowering operation fully automatic.

Will you please send to the attention of the writer the address of the publishers of the house organ (page 58, April issue of APPLIED HYDRAULICS) which was devoted to a survey of fluid couplings and torque converters.

H.E.P.
Montpelier, Vt.

The name of this company, a major oil supplier, has been sent to you. We are confident that they will send you a copy.

About a year ago you ran a short article in your Aviation section regarding a Good Practice Handbook for the Design of Hydraulic and Pneumatic Systems which was in preparation. Has this Handbook been published and how can we secure a copy?

L.K.H.

The "Recommended Good Practice Manual" is still in process and we do not know how long it will be before it will be finished and published. However, we will publish this information when it is available and also the method of distribution.

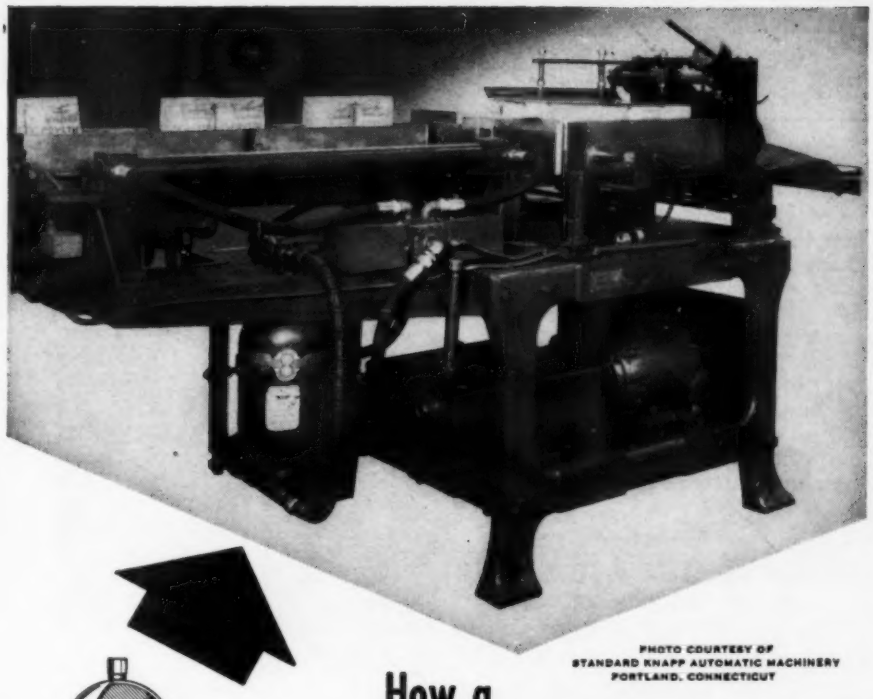


PHOTO COURTESY OF
STANDARD KNAPP AUTOMATIC MACHINERY
PORTLAND, CONNECTICUT

United States Patents Under Oleer Licenses

How a GREER ACCUMULATOR Improved the Operation of This Packaging Machine

THE packaging machine shown above and manufactured by Standard Knapp is but one of many similar machines used to collect and ultimately insert various types of boxes, bags and bottles in containers according to predetermined patterns. This is accomplished in various ways, the most common being gravity or by means of a ram or pusher. The feed conveyor shown here brings the individual bags to a position in front of the side pusher which shears off the predetermined number. When the load pattern is in front of the main pusher it is transferred into the shipping container.

The two pushers were formerly operated mechanically by a slider crank mechanism. Redesigning the unit to incorporate hydraulic pushers and a Greer Accumulator resulted in many important advantages. The use of the Greer Accumulator resulted in:

1. A considerable saving in labor and materials.
2. A reduction in size of pump required.
3. A saving in space and cost.
4. Greer Accumulator provides the constant pressure so urgently needed for a positive transfer of the product.

Redesigning your own process or machine to incorporate a Greer Accumulator, you too can enjoy numerous advantages. Our representative in your territory will be happy to discuss your individual problems. A request for further information to our engineering department will bring an immediate reply.

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

YOUR SYMBOL OF SERVICE

GREER
HYDRAULICS INC.
454 EIGHTEENTH ST., BROOKLYN 15, N. Y.

NEW PRODUCTS

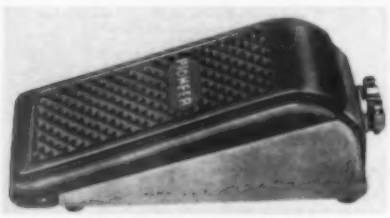
(Continued from page 22)

Five Element Scavenging Pump

Great Lakes Mfg. Corp. announces a new five-element scavenging pump, gear type, for aircraft use. The pump consists of four 3 gpm elements and one 5 gpm element; each element has a separate suction port and a common discharge port. The pump develops 80 percent of its rated capacity with a 4 in mercury absolute inlet pressure and a 200 psi discharge pressure. The new pump which weighs only 3.7 pounds, operates at a continuous speed of 3860 rpm. *9.*

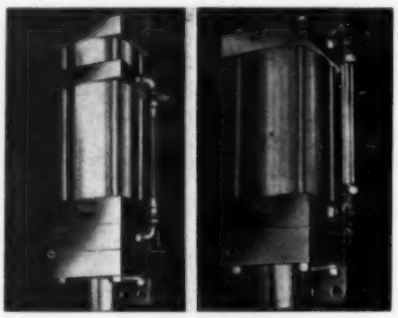
Foot Switches

Pioneer Patents and Products Co. has brought out their new line of foot switches available in standard or special models. Momentary-contact and double-action types are available with clamps to connect various types of cable. Standard models are rated 10-12 amps at 125 volts or 5-6 amps at 250 volts ac or dc. *10.*



Fluid Pressure Boosters

A complete line of fluid pressure boosters for developing working hydraulic output pressures up to 10,000 psi are now being offered by Miller Motor Company. Especially recommended for supplying fluid power for driving working cylinders in clamping, punching, shearing, riveting, welding and similar applications, the booster units offer savings in space, weight and cost. Input pressure may be air or hydraulic, output is always hydraulic. Available in a wide range of pressure ratios and mounting styles, almost any desired size and power output may be selected. Models include single acting spring return boosters (right, in illustration) and double acting "Air Miser" boosters (left, in illustration) that save up to 95 percent of air consumed in single acting circuits. *11.*



CIRCLE NUMBERS ON THE CARD AND MAIL!

Improved Flexible Coupling

Improvements in the Type "C" and "H" couplings, which assure easier installation and larger bore capacity, have been announced by the Lovejoy Flexible Coupling Co. These couplings are designed for use on motor or engine driven pumps, compressors, generators, pulverizers and other machinery of 50 to 100 hp. Redesigned, the inside sleeve is made in two parts and machined for removable steel collars. The bodies are interchangeable and the collar can be put on either half and held secure by a snap-ring. *12.*

BETTER BRONZE PARTS FOR ALL TYPES OF PUMPS

American Crucible methods, know-how, experience and equipment result in highest quality parts at attractive savings to you.

Thrust plates, bearing plates, pressure plates, bushings, seals and connecting rods, machined or rough cast from

PROMET THE Engineered BRONZE

of the specific formula best suited to each application. That's why they carry a

MONEY-BACK GUARANTEE OF LONGER SERVICE—LOWER MAINTENANCE COST.

PROMET BRONZE BAR STOCK

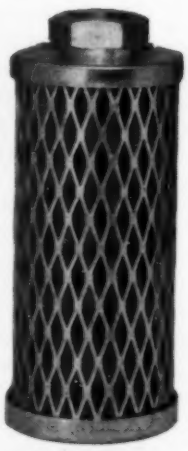
Round, solid or tubular. Rough cast or fully machined. Cored stock all sizes (by ½" steps) from ½" minimum core to 26" O.D. and 13" lengths or less. Six grades of hardness.

Write for literature or let us make recommendations and quote you. Simply send blueprints, conditions of operation and other data.

THE AMERICAN CRUCIBLE PRODUCTS CO.

1303 Oberlin Avenue • Lorain, Ohio

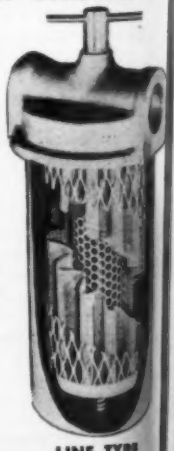
NOW OVER 125 MANUFACTURERS MAKE MARVEL SYNCLINAL FILTERS THEIR O.E.M. CHOICE



SUMP TYPE

These efficient, versatile filters adapt readily to all installation needs, give more filtering area in same space than like size circular units. Both sump and liquid line types operate at full efficiency in any position and can be installed at the angle most convenient for your machine. Either type may be disassembled, cleaned and reassembled in minutes. Removing a single handnut on the line model releases the housing for a quick cleaning without disturbing pipe fittings. Adaptable to your needs in every way, Marvel Synclinal Filters are available with wire mesh sizes from coarse 30 to fine 200. Individual capacities are from 5 to 20 g.p.m., and greater capacities are obtainable by multiple installations.

For efficient filtration of non-corrosive liquids in all hydraulic or low pressure circulating systems Marvel has your answer. Write for catalogs 104 and 102.



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Plastic and Rubber Products, Inc.

is NOW

Precision Rubber Products Corporation

The only change ...is in the name!

Precision Rubber Products Corporation is the *new name* for your *leading* source of supply for "O" Ring Seals. Nothing else has been changed . . . Precision Rubber Products Corporation *will continue* to produce the *same* precision-built "O" Rings, using the same compounds and the same careful quality control as in the past.

Our *new name* accurately describes what we have been doing for many years . . . making precision "O" Rings and other close tolerance molded parts from rubber-like elastomers. *We Do Not Mold Any Plastic Parts.*

No change in quality, management or service. The same personnel you have dealt with in the past are anxious to serve you now. *The only change is in the name!*

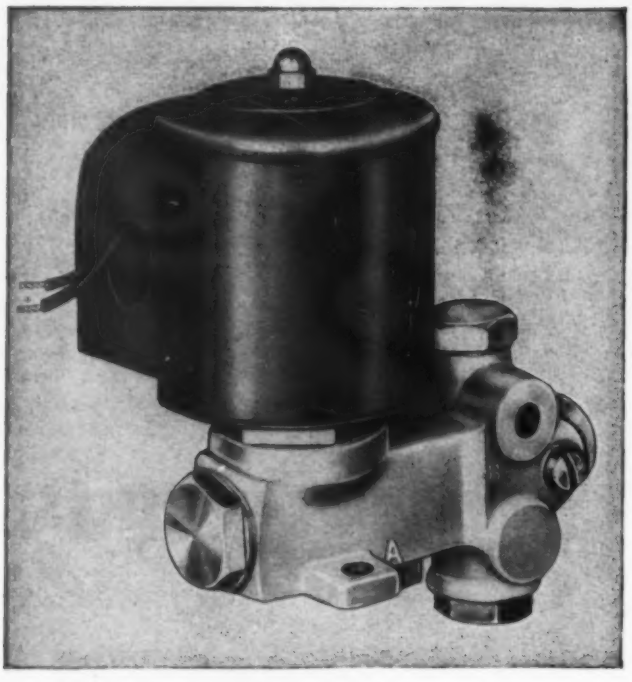
Precision Rubber Products

CORPORATION

Formerly Plastic & Rubber Products, Inc. Dayton, Ohio

The "O" Ring Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio



3-Way Solenoid Valves

. . . ideal for pilot control

Do any of the machines you are designing require a control for automatically applying and releasing pressure from some pressure actuated device or part? We have in mind such machines as:

- AIR OR GAS COMPRESSORS
- CAN MAKING MACHINERY
- TIRE BUILDING MACHINERY
- DOOR OPENERS
- DIAPHRAGM PUMPS
- POWER PRESSES

A simple and dependable device for this purpose is the ASCO 3-way Solenoid Valve! Its function is to open and close ports as required by electrical impulses from a timing device. Many varieties are available; also sizes, the larger units being the packless pilot controlled type in contrast with the smaller direct operated solenoid valves. Many units also are available with explosion-proof and water-proof solenoids.

Tell us about your control requirements. We'll be glad to recommend the type we feel best for your purposes. Be sure to give complete details as to nature of gas or liquid handled; temperature, viscosity, volume, etc.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

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APPLIED HYDRAULICS DIGEST

Abstracts, summaries and listings of articles on hydraulic and associated applications in industry; reports on prepared papers, talk and discussions pertinent to the hydraulics field.

Maintenance Of Hydraulic Systems

M. A. Hayden, Preprint of paper to be presented at the 1950 Convention of the American Society of Lubricating Engineers (Detroit, April 10-12).

The author lists three major requisites for a good hydraulic system: (1) the manufacturer of the hydraulic equipment must provide adequate design, good workmanship and establish conservative ratings; (2) the machine tool builder must apply the hydraulic units correctly and combine the individual units into a hydraulic circuit which meets the performance requirements of the machine; and (3) the user must employ a good hydraulic oil, operate the system within its limita-

(Continued on page 42)

NEW MEAD INDUSTRIAL

AIR POWER CATALOG Ready!

Full of Suggestions for FASTER, CHEAPER PRODUCTION!

Illustrates, describes Air Cylinders, Valves, air operated Presses, Vises, Chucks, Hammers, Drill Press Feeds, Work Feeders, Timers, semi-automatic combinations, etc.

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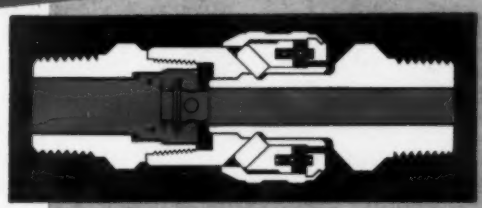
SAVE ✔TIME ✔TROUBLE ✔MONEY WITH THESE HANSEN COUPLINGS

HANSEN PUSH-TITE COUPLING

Shuts off one side of line

Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect coupling, and open line to flow of fluid, merely push plug into socket. To disconnect, a slight pull on sleeve releases plug and shuts off supply end of line.



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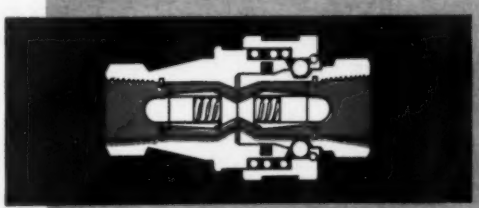
HANSEN HIGH PRESSURE TWO-WAY SHUT-OFF COUPLING

To connect, pull back sleeve and push plug into socket. Identical torpedo type valves permit free flow of gas or liquid through coupling. To disconnect, pull back sleeve . . . coupling immediately disconnects, valves automatically seal both ends of line. Can be mounted to disconnect automatically where fluid lines may be subject to sudden, damaging strain.



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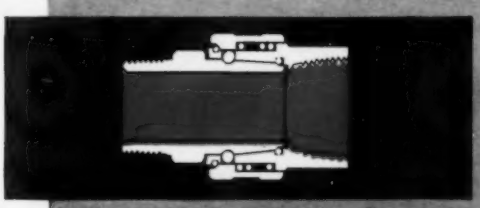
Provides quick connection and disconnection, but does not have shut-off feature. Size range for general use from ¼" to 2½". Two special types of straight-through steam couplings also available—one for low pressures, and one for high pressures.



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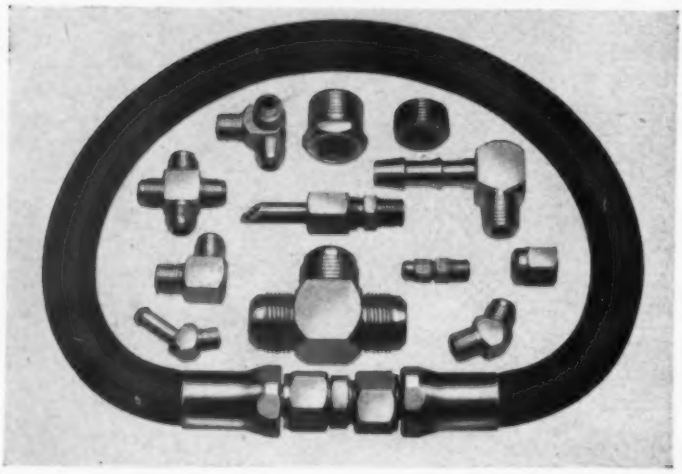
LET L & L SERVE YOUR

HYDRAULIC PIPING NEEDS



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  for 1/8th to 2 inch O.D. tubing
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  3 PIECE LOCK-JOINT-SLEEVE TYPE

- **HOSE ASSEMBLIES**

  with pressed-on couplings for single and double wire braid hose

- **PIPE FITTINGS**

  Straights, Ells and Tees with "Dry-seal" pipe threads (N.P.T.F.)

- **PRE-FABRICATED TUBES**

  Let us estimate your preformed tube assembly needs.

• Your installation problems are solicited. Write for catalog and technical data. We also have technical and sales representatives in your area for your convenience. All standard items are shipped from stock the same day your order is received. Excellent service on "Specials".
A few select territories are still available to progressive distributors of Hydraulic equipment—Inquiries invited.

Hydraulic Accessories

L & L Manufacturing Co.

8088 EAST NINE MILE RD. VAN DYKE, MICH.

(Continued from page 40)

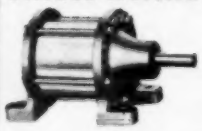
tions and use personnel qualified to properly and systematically maintain the equipment. A recent analysis indicates that 95 percent of the service problems with hydraulic systems of machine tools are within control of the user; problems that can be eliminated by co-operation between the manufacturer of the hydraulic equipment, the machine tool builder and the user for the purpose of instructing maintenance men in basic hydraulics as applied to the equipment they maintain. The author believes that the user can make the largest contribution by recognizing his need for qualified hydraulic maintenance men and acting on this need.

Automatic Air Controls on Laundry Washer
A. M. Brodine, *Compressed Air Magazine,* v 55, March 1950, pp 72, 73.

The automatic control of 59 of the 62 operations required in the cycle of a commercial laundry washer by means of an indexing head, which, through an ingenious use of a perforated metal disc, operates 22 air-operated valves to perform the functions. The unit regulates water level, temperature and washing time for each bath; injects measured amounts of soap, bluing and bleach at the correct intervals; changes the water after each bath and stops the machine at the completion of the cycle. The "formula" for a given wash load is set on the disc by a series of perforations, the disc placed under a T-shaped indexing yoke which is rotated by a geared-head timing motor. As the disc rotates, rows of pins on the yoke pass over perforated holes, opening valves in the prescribed sequence, releas-

AIR-MITE AIR CYLINDERS

SINGLE ACTING



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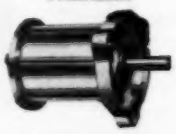

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CHICAGO 12, ILLINOIS

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ing air to cylinders, control head on a float tank or dump valves through air cylinders to perform a specific sequence of operations.

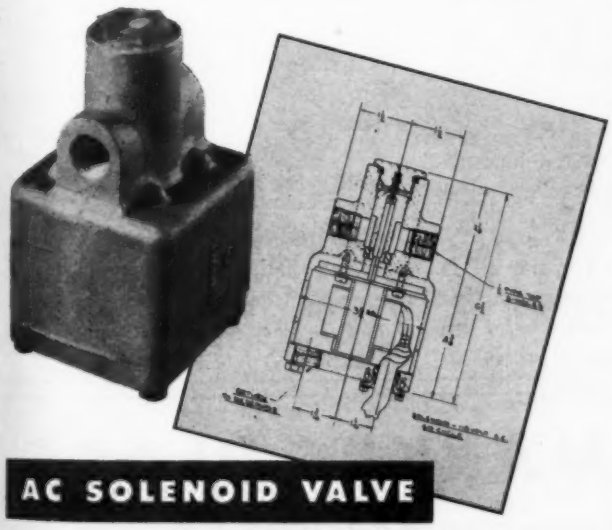
The new air machine control is marketed by The American Laundry Machinery Company as the Cascade automatic washing control.

Proceedings Of National Conference On Industrial Hydraulics

Proceedings by Armour Research Foundation and Graduate School of Illinois Institute of Technology. Volume III, 218 pp. Technology Center, Chicago 16, Illinois, $3.50.

A complete text of all the papers presented at the fifth annual meeting, in October 1949, of the National Conference on Industrial Hydraulics. These papers were prepared by manufacturing, engineering and research executives in the hydraulics field. Recent developments in earth-moving equipment, power conversion and large hydraulic valves are discussed. The design of hydraulic seals, a discussion on synthetic hydraulic fluids and a comparison of hydraulic and electric servomotors are presented on the subject of hydraulic equipment components. Other papers are included on subjects of design consideration, hydraulic equipment standards and hydraulic circuit performance.

A total of nineteen papers are included, the largest number presented at any of this series of conferences. The work clearly shows the growth of industrial hydraulics and the close relationship of the many hydraulic problems and applications in the various fields.



AC SOLENOID VALVE

- **1500 PSI and 3000 PSI**
- **Flow up to 10 GPM**

Completely enclosed . . . specifically designed for extremely dirty and hazardous installations.
Write for data sheet giving complete information on this solenoid operated valve.

Specialists in Hydraulic and Pneumatic Development

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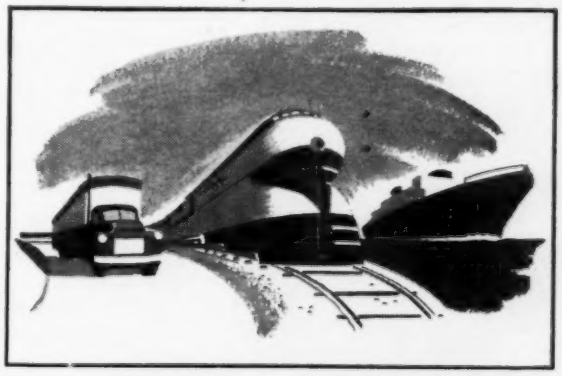
Bendix-Skinner

ORIGINATOR OF **MICRONIC** FILTRATION

the *Finest*

Answer to Any Filtering Problem



For over twenty years ***Bendix-Skinner*** has specialized in solving the filtering problems that "couldn't be done." From this experience has come entirely new and exclusive filtering techniques which do even the work-a-day filtering jobs better and at lower long-range cost. Tell us about *your* problem—nine times out of ten ***Bendix-Skinner*** filters will supply the "finest" answer.

***Over 350 Models** providing filtration from ½ micron (.000019") upwards at flow rates from 1 to 5000 g.p.m.*

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IN THESE HYDRAULIC PUMPS and FLUID MOTORS

There's plenty of power in Eastern fluid motors and hydraulic pumps. They're tough and compact—ideal where space is at a premium. They're dependable, too. Long life under rugged operating conditions is built-in. An Eastern hydraulic pump or fluid motor in your design is good engineering.

SERIES 100

.1 to 5 GPM—Drive speeds up to 3450 RPM. Working pressures up to 1000 PSI. Average volumetric efficiency: 90%. Average model weight: 1.65 lbs.

Lightweight construction is obtained through use of aluminum housings and nitralloy gears and shafts. Each unit is factory pre-tested for precision and operating efficiency.

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POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

H. G. Taylor, president, Plastic and Rubber Products, Inc., Dayton, Ohio, announces a change in the name of the company to Precision Rubber Products Corporation. Mr. Taylor emphasizes that the change is in name only and that no management or personnel changes are involved. The new name, Precision Rubber Products Corporation, is not only a more accurate identification for the line of "O" rings in which the company specializes, but also avoids confusion with another company whose name was very similar. Mr. Taylor points out that the two companies are independent organizations, under totally different management and expresses a hope that the change in name will be useful in adequately identifying PRP Corporation and that it will not inconvenience any of the users of their well known line of approved "O" rings.

Mr. Taylor

A. Schrader's Son has named D. F. Cisney as advertising manager, replacing D. S. Hunter, who has resigned. The company also announced that Wallace C. Manville has been appointed Schrader's resale representative in the Denver area.

Mine and Smelter Supply Co., 1422 Seventeenth St., Denver, Colorado, has been appointed representatives for Hydro-Line Mfg. Co. in the Denver and El Paso territory.

Alexander Toben has rejoined Ledeen Mfg. Co., Los Angeles, California. Most recently he has been associated with Cardwell Mfg. Co. With both European and American experience, Toben is to take an active part in the sales and application design of hydraulic and pneumatic actuating cylinders as well as other equipment. He will also aid in introducing the new medium duty cylinders recently added to this company's line.

Mr. Toben

Raybestos-Manhattan Inc., has moved their Department of Marketing and Merchandising to the executive headquarters, 61 Willett St., Passaic, N. J.

THE MARKET PLACE

CLASSIFIED ADVERTISING

Rates: For "Positions Wanted" $4.00 minimum, limit 25 words. For all other classifications $4.50 minimum for 25 words, each additional word 15c; bold face type or all capitals, $7.50 minimum for 25 words, each additional word 20c; limit 50 words. Box addresses count as five words. All insertions are payable in advance.

These columns are limited to Help Wanted or Position Wanted ads, and offerings of used equipment by the users of such equipment.

Hydraulic Units, Dynamometers and Test Stands (ready and useable for aircraft and equipment tests). Also Universal and General Hydraulic Test Stands complete with Vickers 2008 FHAA variable pumps, and 2305 AH pumps, flow meters, etc., driven by Louis-Allis 10 H.P. motors. Save 30-50% on complete unit, pumps, tanks or motors.
Pictures, prints, full descriptive literature sent upon request.
Box-41, Kensington Station, Detroit (24), Michigan.

Goshen Rubber and Manufacturing Co., Inc. has announced the addition of two new distributors: The Alan Company, 1414 Victoria Ave., Cleveland 7, Ohio and Machell Rubber & Supply Co., 1730 North 12th Street, Milwaukee 5, Wisconsin.

Geo. D. Roper Corp., through F. R. Dickerson, sales manager, announces the promotion of J. M. Hoskinson to sales engineer, Pump Division. Mr. Hoskinson's principle duties will be providing a consultation service for application of Roper rotary pump products. He had broad engineering experience in the machine tool engineering field prior to joining Roper Corp. in 1939. Hoskinson was recently appointed chairman of the Technical Committee, Rotary Pump Division of the Hydraulic Institute.

Mr. Hoskinson

Haskel Engineering & Supply Company has opened their Northern California division office at 1245 22nd St., San Francisco 7, California. This division will be known as Haskel Engineering & Supply Co. of Northern California and will be under the management of E. C. Osborn. A complete stock of mechanical and homogeneous molded packings will be carried and industrial hydraulic equipment will be added within a few months.

Great Lakes Mfg. Co. have expanded their facilities for developing and manufacturing pneumatic and hydraulic equipment for aircraft and industrial use, and along with their expansion program, announce the election of of John A. Kanuch as president. Kanuch was formerly assistant chief engineer at Pesco Products Division where he was associated for 13 years. Prior to that time he was associated with General Motors Diesel Division in Cleveland as design engineer.

Mr. Kanuch

Basic Hydraulics Questions, Chapter 6

1. What is meant by a compound valve?
2. Why is a pilot valve used in compound relief valves?
3. Why can compound relief valves be used for higher pressures than simple relief valves?
4. Why does the main piston of the Vickers relief valve and the Northern simplex valve rise from its seat?
5. What is meant by venting a valve?
6. How do pressure reducing valves differ from relief valves?
7. How does the check valve in the Logan pressure reducing valve 8036 permit reversal of flow?
8. Will the 8036 valve handle the same volume in both directions of oil flow? Explain.
9. Why must the drain be directly connected to the reservoir? Why is it important to keep the drain line open?

Chiksan Co., Brea, California, has established a warehouse stock in the Federal Storage Building, 155 Washington St., Newark 2, N. J. The company has appointed Robert S. Hudgins, Jr., 118 N. Chase St., Charlotte, N. C., as their representative in North and South Carolina. The Southern Corporation, Charleston, South Carolina, will continue to represent Chiksan in the pulp and paper industry in these states. R. S.

SPECIFY LINDBERG AIR CYLINDERS

for

PULLING
PUSHING
LIFTING
FORCING
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PRESSING

No costly mechanisms needed!

Lindberg Double Acting Air Cylinders are proving their adaptability and worth in a wide variety of industrial uses. These simple, dependable, efficient and versatile cylinders are effecting considerable savings throughout industry by the reduction or complete elimination of costly mechanisms involving cams, gear drives and complicated set-ups.

Don't forget—with slight modifications, any size or model of Lindberg Air Cylinder may be used for low pressure hydraulic applications.

WRITE FOR NEW BULLETIN 731—this 16 page catalog just off the press gives details of all standard Lindberg Air Cylinder models and sizes with complete tables on bores, pressures, weights, mountings and conversion to low pressure hydraulics.

Remember—BULLETIN 731 for COMPLETE DETAILS ON AIR CYLINDERS

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when you need HYDRAULIC CYLINDERS
OIL HYDRAULIC PUMPING UNITS
MILL TYPE CYLINDERS • CENTRIFUGAL
BLOWERS • AIR VALVES

NEEDS NO SEALING COMPOUND

UNBRAKO

DRYSEAL

THREAD

PRESSURE PLUG

. . . seals pressure-tight without the use of sealing compounds. Features the "Dryseal" Pipe Thread originally developed for use with SO_2, ammonia, and other refrigerants. Offers a valuable solution to leakage problems in high pressure equipment of all kinds.

Unique design of the "Dryseal" Thread provides actual crushing and sealing at both major and minor diameters, effectively preventing spiral leakage, even under extreme pressures.

Incorporates all the important features of the regular UNBRAKO Pressure Plug, including fully formed threads, uniform taper and perfect roundness.

A full range of sizes from 1/16" to 1¼", National Pipe Thread Fuel, is available. Full details are given in Bulletin 675.

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STANDARD PRESSED STEEL CO.

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Stover Co., Kresge Bldg., Marshalltown, Iowa, has been appointed to cover Iowa and Nebraska.

Unimax Switch Division of the W. L. Maxson Corp., New York, has appointed Mark M. Hennessy, Mae Strauss Associates, 610 W. Michigan St., Milwaukee, Wisconsin as representative for Wisconsin. H. W. Walton, 1010-11 Francis Palms Bldg., Detroit, Michigan, has been named representative for Michigan.

NP PRE-ENGINEERED Pneumatic DOOR OPERATORS

- Speed material handling
- Isolate dust and fumes
- Isolate fire hazards
- Reduce cost of air conditioning and heat

Powered by the air engine that operates the car doors of the world's subways

Write for bulletin DC-102

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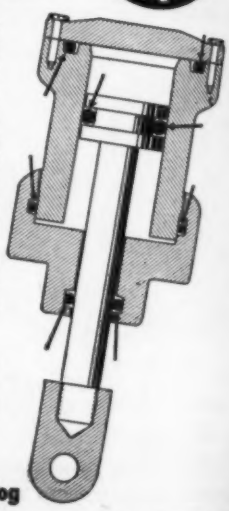
O-RINGS by INJECTION MOLDING

Dependable Hydraulic Seals

Minnesota O-Rings function in air or gas systems as well as in hydraulic systems. Air cylinders . . . hydraulic valves . . . hoisting mechanisms . . . water pumps . . . bottling machines . . . refrigerators . . . motors . . . lubricators . . . are a few of their uses. Minnesota's exclusive injection process makes possible very close dimensions, uniformity in mass production and downright economy. We use special compounds of synthetic rubber to meet your exact requirements. Let us quote on your next hydraulic packing installation.



Manufacturers of all types of small rubber parts

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MINNESOTA RUBBER & GASKET CO.

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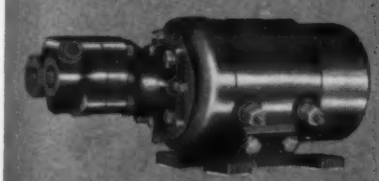
Another Job for Pesco HYDRAULIC MUSCLES



Illustrated above is a Pesco electric motor-driven hydraulic pump of the type used on smaller automatic trucks. It has a displacement of .043 cu. in. Capacity is .67 g.p.m. at 3000 p.s.i. at 33 volts D.C. and 76 amperes.

A Pesco pump is lifting this load...

IT COULD LIFT OVER TWICE AS MUCH!

Over 80,000 pounds can be lifted and transported by this die handler built by Automatic Transportation Company.

Yet the Pesco hydraulic pump that supplies the power to lift such terrific loads is so small it can be carried easily in your hand!

One important reason why more and more industrial equipment manufacturers are turning to Pesco for answers to their hydraulic power problems, is *"Pressure Loading"*. *"Pressure Loading"* is the exclusive, patented Pesco design principle that assures extremely high operating efficiencies over a long, trouble-free pump life because it *automatically* compensates for wear.

For the complete story of *Pesco Pressurized Power and Controlled Flow,* and how the sales power of Pesco hydraulic power can help you, write today.

A preliminary discussion will involve no obligation.

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a bride...

or a graduate...

or a new baby...

or a birthday girl?

Chances are you're trying to dream up the perfect gift for one of these lucky people!

And what gift could be more wonderful for any or all of them—than a crisp U.S. Savings Bond!

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U.S. Savings Bonds do not lose their value if they're lost, stolen or destroyed.

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